THE VICTORIA READERS

BY

W. J. POPE

BOOK V.

FOR STANDARD V.

SMITH ELDER & CO.

THE

VICTORIA READERS

BOOK V.

A SERIES OF LESSONS

ON

FOOD

BEVERAGES

THE SKIN

PERSONAL CLEANLINESS

FOR STANDARD V.

BY

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PREFACE

THIS book has been carefully prepared in narrative form as a general class reader. Great care has been taken in the choice of language to make it a book for pleasant reading, and not one of facts alone. A chatty style has been adopted, and the lessons form a continuous series exactly in accordance with the Syllabus of Domestic Economy for Standard V., as laid down in the Code.

W. J. P.

LEWISHAM BRIDGE SCHOOL,
LONDON, S.E.

Extract from the Instructions to Her Majesty's Inspectors.

"All that is purely technical, whether in the mode of study or in the language and terminology, should be carefully avoided."

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THE VICTORIA READERS

INTRODUCTION

"AND how did you get on at the examination to-day?" said Mrs. Hall to her daughter Ruth, as she came in from school on the day the inspector had been.

Ruth had brought Bessie Burgwin home to tea with her; and, as she hung up her hat and cloak, she said to her mother, "I do not think we did very well: I think Miss Weston is very disappointed with our class."

"Did the inspector ask you a lot of hard questions?" continued her mother.

"No," replied Ruth, "he did not ask us for one half of the hard names we had got up in our Domestic Economy. We had learned such a lot: and I am sure the girls knew them very well.

"Now and then the inspector seemed a little put out, when we mentioned 'nitrogenous' and some other long words, and

could not quite explain to him, in our own words, what they meant. He kept asking us simple questions, such as 'What is it like?' 'What is the use of it?' 'How do you know?' 'What would you do with it?' and so on."

"Then," said Mrs. Hall, "the inspector was not like the professor who, last winter, lectured on food at the Institute. If you remember, he used all the hard words he could think of, so that neither your father nor any of you understood what he meant."

Just at that moment Ruth's father came in. He had knocked off early as he called it, and, as it was raining, he stayed in for the evening.

Whilst they were at tea Mr. Hall said to his wife, "Were you talking about Professor Woodman when I came in? I thought I heard you speaking about that lecture to which we went last winter. Of all the miserable hours I ever spent, I think that was really the worst. At the time I well remember saying, 'If using language, which ordinary people cannot understand, makes a man clever, the professor was clever indeed. What a pity it is that so many clever people have not the common-sense to use common words, which ordinary people can understand.'"

When her husband had finished, Mrs. Hall told him what Ruth had said about the examination.

"And quite right too," replied he. "Names are all very well in their way. The inspector was quite right: As time runs on we forget

names and dates and numbers; but we do not forget why things are done, and how they are done, if we have been sensibly taught, and have had the things shown and simply explained to us. If examinations are to be all names, the fewer we have of them the better."

As it was a wet evening, and as Thursday was closing day in that part of London where the Halls lived, Mr. Creswell the chemist, Mrs. Hall's brother, dropped in for an hour or two. At the time, George was putting a paper bag over the head of the cat, and Ruth and Bessie Burgwin were hunting on a map of China for Canton.

After Mr. Creswell had been in about half-an-hour, and had had a few words with Mr. Hall about the weather, and what he called the everlasting mud in the streets, he asked Ruth how she had done at the examination.

"Oh! I don't know, not very well, I think," replied Ruth.

"And why not?" said her uncle.

"Because what the inspector asked we did not know; and what we did know he did not ask us," said Ruth.

"Never mind," replied Mr. Creswell, "it will be all the same in a hundred years' time. What is your Domestic Economy about this year?"

"About the composition and the value and the uses of food," answered Ruth.

"And about the skin and personal cleanliness," added Bessie.

"Yes, I did not forget that," said Ruth.

"That is easy enough. It is the food which is so difficult."

"And how do you know whether it is difficult or not," broke in her uncle, "when you have not yet begun the year's work?"

At that instant Ruth's elder sister, Mary, came in; and, as she had spent a year in Ruth's new class, she was able to answer for Ruth, and she told her uncle that had it not been for the explanations her teacher and he had given them last year, she would have known next to nothing about it. "The books have such fearful-looking names," said she, "and such queer-looking chemical letters and figures, that school-girls cannot read them."

"I must say," said Mr. Hall, who was a very thoughtful man, but whose early education had been neglected, "that I think some folks carry the details of school work a little too far. Some folks, I know, say you should know all about a thing, or nothing. Now I do not believe in that. I think we ought to *well know a little* about most things. No one would say, because we cannot know everything about Russia or China or the moon, that, therefore, we should know nothing about them. I must say I think children should be taught something about their food; but there

is no need for them to be worried with all that is known about it."

"That is exactly my idea," said Mr. Creswell. "It is a great pity to be totally ignorant about the common things we see every day. I will drop in now and then and see what we can do in the way of making things simple. Here, George, you went to these lectures, did you not?"

"Yes," replied George, "and I went to sleep too."

"But you remember the evening conversations we had over the food and the circulation of the blood."

"Yes, I remember that; but I cannot read it in books any more than Mary or Ruth can."

"Well, I must say, as I said last year, that I cannot see how you can understand that food makes the body grow, unless you know how it gets to all parts of the body," continued his uncle.

ELEMENTARY CIRCULATION.

"Do you remember, Alfred," said Mrs. Hall to her brother, "that I nearly cut off the top of my thumb last year? I was cutting some

bread at the time, and I told you that I as near as possible bled to death."

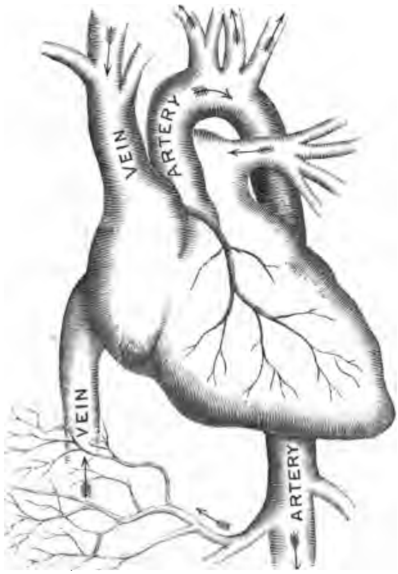
"Yes, I remember," said Mr. Creswell, "I could not help smiling at the time, and when I asked you how much blood you had lost you told me nearly half-a-pint. When we are in trouble we often make it appear to be ten times worse than it really is. I told you then that you had actually lost but little, as in an ordinary person there are at least nine pints."

"Well, now, even that little fact was news to me," broke in Mr. Hall. "Until you explained it I did not quite know that the blood was in multitudes of pipes, through which it ran to and from all parts of the body. I am afraid that I thought the flesh held the blood something in the same way as a sponge holds water."

"Yes, I remember," continued Mr. Creswell, "you said so at the time; but I explained it as clearly as I could. Now, Ruth, listen to me. You know if you fill a bladder with water, and tie it tightly around the neck, that all the water will dry out in time. In the same way if you blow out a bladder with air, and by tying a weight to it sink it in water, the air will come out

and the water will go in. From this it is very plain that the air and water, that is, gases and a liquid, can pass through a bladder or skin.

"Now, in the flesh of the body, in the



bones, in the skin, in the liver, and the intestines, and in all parts of the inside, there are multitudes of pipes, some as large as your fingers and some as small as $\frac{1}{2000}$ of an inch. Through these pipes the blood is

always flowing, as the heart is always squeezing blood out of itself into them. At times you can easily see the cut ends of pipes in meat, both before and after it is cooked.

"If," went on their uncle, "you examine a heart, you can see pipes leading into and out of it. Through some of these pipes blood flows in, and through others it flows out. Those through which blood flows from the heart are called arteries, and those pipes through which blood flows to the heart are called veins. As from birth to death, the heart is always at work pumping or squeezing blood out of itself, the blood must flow through the pipes; and as the heart contracts about seventy times in a minute, you can feel the pulse the same number of times.

"Now, George, do you remember my telling you all this last winter?"

"Yes," replied George, "I remember it, but I had forgotten it."

"Oh! no, you do not forget everything you cease to think of. It mostly remains in the mind until it is wanted.

"Well," went on George's uncle, "the heart is in the chest, protected by the ribs; and the chief pipe which comes out of it is nearly an inch across. The further it goes

away from the heart the smaller it gets, somewhat as you see in the diagram; and the further it and its branches go, the smaller do they become, until they become too small for the eye to notice. These extremely small, thin blood-vessels are called capillaries; and to see them the eye must be helped by a good microscope.

"The arteries take blood from the heart to all parts of the body, much in the same way as iron and lead pipes take water from the water-works to all parts of a town or village.

"Of course I need not tell you, Ruth, that the smaller the pipes, or blood-vessels, as they are called, become, the thinner they also get. Well, through these thin pipes the blood oozes or soaks; and in that way, the food, which, by means of the stomach, we put into the blood, is carried to all parts of the body where it is wanted."

"But what is the blood, what is it made of?" asked Ruth.

"Well, it would be unwise to try and explain to you at your age," replied her uncle; "but the blood is mostly water. It contains other things as well; but the chief thing for you to understand is that it contains food, after it has been prepared in the mouth

and stomach and intestines and absorbed into the small blood-vessels."

"And why is blood red?" asked George.

"If you take a basin of water and put into it a number of small red seeds, the water will appear to be red if you stir up both the water and the seeds. The blood is red for the same reason," replied Mr. Creswell. "In it there are millions of very small red corpuscles, as they are called, and it is owing to these that the blood is red."

COMPOSITION OF FOOD

Two weeks after Mrs. Hall's brother had explained to her and her husband and children, how the blood travels to all parts of the body, he came again to give them what he called a simple lesson on the composition of food. That evening he closed his chemist's shop early and came to tea. After tea he and Mr. Hall spent some time in pruning some young fruit trees in the garden; but, as soon as it was fairly dark, they went into the sitting room, where his sister and her children were reading.

"I have often wondered," began Mr. Hall,

"how it is that leaves and blossom and apples and pears will, in the summer, come out of the trees we have just been pruning. Now, they are simply bare trees, for all the world like dark green sticks and nothing more. Surely the leaves and blossom, with their various colours, and the fruit, with its different tints and flavours, do not come entirely from the earth in which the trees are planted."

"Never mind that now," said Mr. Creswell. "We must and will see to that further on. I want this evening to give Mary and Ruth and George a lesson on the composition of food; and I do not think I can do better than go over it, as nearly as I can, in the way I did last year. I, at the time, took some trouble to think out the simplest way in which it could be done. I have, however, either mislaid or lost the notes I then wrote; but I will, as nearly as I can, go over it in the way I did then.

"If I remember rightly you had at that time been living in London about a year, and that, at the school at Epsom, Mary and Ruth had learnt something, but not much, of the construction of the body. They fairly well knew the names of the various parts, and that was about all they did know. Unless

I make a mistake I began with George, so I'll begin with him again.

"Do you know, George, why you eat food?"

"Because I like it," replied George, "and because I sometimes feel hungry."

"But what good does your food do you?" said his uncle.

"It makes me grow," again replied George.

"But mine does not," said Mr. Creswell.

"Mine does, though," answered his nephew. "The coats and the trousers I wore last year are far too short for me now. My legs stick out ever so far below, and my sleeves seem to be half way up to my elbows. And besides that, I am much heavier than I was."

"And what would happen to you if you were taken very ill, and had to be fed on a little gruel and beef-tea?"

"I expect I should almost stop growing, and that I should get very thin," answered George. "Harry Green fell off a tree in the park last summer, and hurt his back and had to lie in bed for three months. When he came out of doors again, he was nearly skin and bone."

"Yes," said Mary, "and I do not think he could have weighed one half of that which

he did before his accident. But he is all right again now?"

"And I suppose he is getting stouter and heavier?" said her uncle.

"Yes, I think he is bigger now than he used to be," replied Mary.

"Now I wonder," said Mr. Creswell, "whether Ruth can tell us where Harry Green's new flesh and fat came from?"

"From the food he has eaten since," answered Ruth.

"But, George, suppose he had not eaten any animal food. Suppose he had not been able to eat any meat of any kind, would he have grown taller and stouter," went on his uncle. But neither George nor Ruth was able to answer the question.

For a few moments, however, there was perfect silence, and then Ruth happened to remember that her uncle had asked the same question last year; and so she replied—
"Every one has meat in some way or other. Some people do not eat mutton and beef and pork; but they eat butter and eggs and milk and cheese, and these are something very like meat, since they all come

from animals as beef and mutton and pork do."

"Now, Mary, do you remember what I said about the farmer who kept a calf until it became a cow?" asked Mr. Creswell.

"Yes," at once said Mary, "I remember exactly, because I had neither heard of it nor thought of it before. You asked us—if a farmer put a young calf in a field until it became a cow, where would its lean and its fat and its skin and its bone have come from?"

"Well, and whence did the young calf get the material which made it grow?" said Mr. Creswell.

As on the last occasion, all the Hall family were silent. Now, as then, they did not plainly see how the change had come about. George and his sisters knew that as they grew older they grew heavier. They knew that they had eaten bread and meat and cheese and butter as well as other things, and they knew that their bodies had been formed from the many things they had eaten. The calf, however, had eaten nothing but grass, as the farmer had kept this particular one locked up in a field and fed on nothing else.

All the family could see that the many

things they had eaten could be changed into the many things of which their bodies were made. But the calf had been fed only on grass, and they could not understand how the grass could be changed into flesh and fat and skin and bone and hair, as well as into the

other things of which a cow is composed. That veal should be changed grass and nothing more, was beyond their understanding.

If they could have seen how veal was formed from grass, they would never have wondered at the marvellous tricks of con-

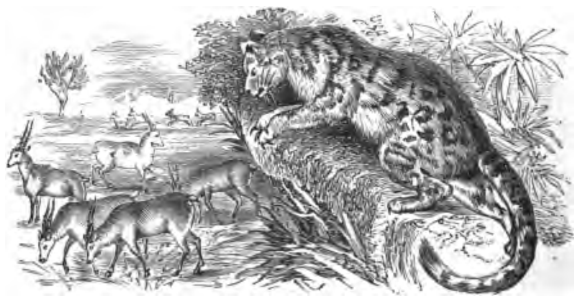
jurers. They would as easily have seen that mutton was formed from grass and turnips and other vegetables given to sheep as food.

They would also as easily have seen that wild oxen are made of grass and other foods which they find on the prairies; and tame ones from the grass and hay and corn given

them by the farmer at home. The elephant, the strongest of land animals, is formed entirely of vegetables, whilst the strong lion is formed entirely of flesh, that is to say, of other animals. Similarly rabbits and hares and scores of other animals live entirely on vegetables; whilst tigers, panthers and

leopards, and other similar animals, live entirely on the flesh of animals.

Animals which kill and eat other animals are formed from what these animals contain. But if these animals, such as deer, live entirely on vegetables, it is very plain that a lion or a tiger, living entirely on deer, is formed entirely of the vegetables which had been eaten by the deer.



In the same way eagles and other flesh-eating birds live entirely on other birds and animals; but these in their turn have fed on corn and seeds and plants which grew out of the earth. So it is plain that if animals live on plants, and plants come out of the earth, animals come out of the earth also.

"But," said Mrs. Hall, "there are some

animals which do not live entirely on other animals, nor entirely on plants. Cats will eat meat, and they will also eat potatoes; and dogs will do the same. In the same way a canary in a cage will eat seeds, but it will also eat chopped eggs and meat."

"Yes, I know that," replied her brother. "But the egg comes from a fowl, and the fowl lives on corn and other things which grow as vegetables; so after all, even a canary comes out of the earth.

"And in the same way," continued Mr. Creswell, "men and women and boys and girls live on both animals and vegetables; and, as the animals we eat feed on plants, it is plain that we contain nothing which the plants do not contain. Inside ourselves, by some means unknown to us, our food is changed into the various parts of which we are composed, just as the grass of the field was changed into the substance of which the calf was composed."

Mr. Hall, during the whole time his brother-in-law had been speaking, had listened with the greatest interest. He plainly saw that plants and animals were exactly alike as far as materials were concerned, but differed only in the way in which they were put together.

"If what you say is true, and it certainly seems to be," he at last said, "all living things are alike."

"As far as what they are made of is concerned," replied Mr. Creswell. "Daisies, buttercups, turnips and geraniums may all be grown in the same garden and in the same bed of earth, and each from the smallest of seeds. The plants will differ in shape and size and weight and bloom, but they will all be formed of the same things, taken from the same earth and air. So, in a similar manner, animals are formed of the same material put together in different ways."

"But, are we to understand," said George's father, "that all plants are formed entirely of earth, because if so, we also are formed entirely of earth?"

"Oh! no, by no means," said his brother-in-law. "Plants take in their food both by their roots and their leaves; but I cannot now go very closely into this. Most of a plant is formed from gases taken out of the air by its leaves. The rest is taken up from the earth by its roots. If the air were quite pure no plant would grow, and therefore no animal could grow. Without plants there could be no animals; and without impure

matters floating about in the air there would be no plants; so strange as it may seem, we, that is men and women and boys and girls, are formed out of the earth and the impurities of the air. This may not be a very dignified subject for some of us to think over, but it is true for all that."

"I think I see all this," interrupted Ruth, "but what do plants take up from the earth?"

"Well," replied her uncle, "there is air in all earth, and the roots take in the same impure matters as the leaves do. But they take up other things as well. When you have a cushion, or a bed, or a pillow, you can always tell what it is made of by taking it to pieces.

"If you burn a plant, and I would advise you to dry a few leaves and twigs and burn them, you drive off most of it into the air; but you have some ashes left. The matters which float away in the air, as smoke and gas, are the impure matters which other plants afterwards take in by their leaves as food for themselves. And it is the same thing when you burn an animal, or pieces of bone or meat or feathers, which are parts of animals. The greater part of the thing which is burnt goes

off into the air; and the gases formed by the burning are taken in by the leaves of plants as their food. So we see that plants become food for animals, and animals when they are destroyed become food for plants. Animals make the air impure; but plants purify it."

"But you have not told us the names of the things which pass off into the air, when animal matters and vegetable matters rot or are burnt," again asked Ruth.

"No," replied her uncle, "and just now I am not going to do so; but I am going to ask you to remember that a plant can, by burning, be changed into gases and ashes."

"Yes, I shall remember that of course," said Ruth, "but of what are the ashes made?"

"I am not going to tell you that either now," replied Mr. Creswell; "but every plant brings up some of the earth in its sap. This dissolved earth is placed in all parts of the plant to harden it, so that its leaves and branches may not droop down close to the stem. No matter what part of a plant you burn you get some ash. Now, if earth be found in all parts of plants, and we eat plants, it is very plain that we take the earthy part of the plants into ourselves. This earth hardens us, otherwise we should

be much softer than we are now; that is, some of us would be. Bone is more than half earth or, as it is called, mineral matter.

"Not only do we obtain the earthy mineral matter, which hardens our limbs and body, from the foods we eat; but we also obtain some from the water we drink. When water is boiled in a kettle, earth, mostly lime, covers the inside of the kettle. If, however, this water had been drunk by an animal, part of the limy earth would have remained in and hardened its body. Thus we see that our food is of three kinds—

ANIMAL
VEGETABLE
MINERAL

Some animals, such as lions and eagles, do without vegetables; and some animals, such as rabbits and horses, do without animal food; but all animals which have bones or shells, must have minerals. The great majority of mankind, however, in all parts of the world, use all three, viz., animal, vegetable and mineral foods. Here and there, some people eat no actual meat; but, if they take milk and butter and eggs they can hardly be said to do without animal food."

SIMPLE CHEMISTRY OF FOOD

On the following Thursday, as there was a circus in the neighbourhood, Mr. Creswell did not go round to see his sister, for he well knew that George would not be at home; but the week after, he put several bottles and powders and other things into a bag, that he might the more easily explain to his nephew and nieces the further composition of food.

Mr. Hall was at home, and after their uncle had spread a newspaper over the table, and placed upon it some of the things he had brought, they all sat around.

As Mr. Creswell was a chemist, and not a teacher, and as he knew that the composition of food wanted very simple and careful explanation, he had asked Miss Weston, Ruth's teacher, to come round to Mr. Hall's house for the evening. She happened to be a friend of his, and so she willingly came.

Elements.—"I think," said Mr. Creswell, "that we had better begin at the beginning, and deal with elements and compounds first. What do you think, Miss Weston?"

"Yes, I think that will be best," she replied. "It seems to me that elementary chemistry is not at all difficult, if we take the things in the

proper order, and if we keep to the work in hand. I quite believe in doing a little well, and in not referring to a hundred and one things which confuse and worry the children."

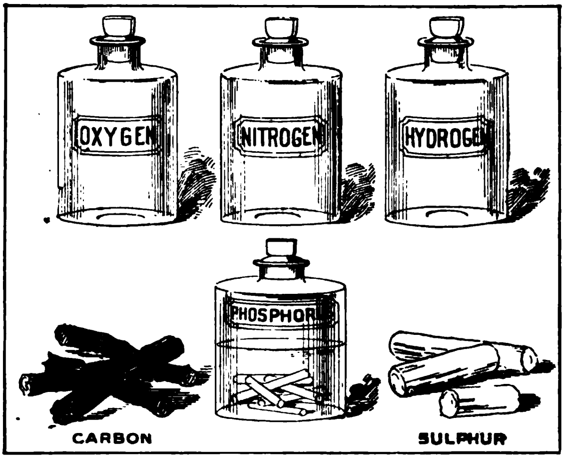
"Just so," said Ruth's uncle. "Now I will show the three children some metals, and let them find out for themselves what they are and what they are made of. Now, Ruth, there is a piece of gold, there is a piece of silver, and there is a piece of copper. I will cut a small piece off the copper. Now, if you cut this little piece in two, and then take one of the smaller pieces and cut that in two, and then keep on cutting each piece until you have so small a piece that you could not even think of its being further divided, you would have an atom of copper.

"The smallest piece would be copper and nothing else. And if I did the same with the gold, the smallest piece would be gold and nothing else; and the smallest piece of silver would be silver and nothing else. Because this is so we say that gold and silver and copper are elements.

"Now do you think you can tell me, Ruth, what an element is?" Miss Weston quite expected Ruth to say that an element was a very small piece of gold or silver or copper.

But Ruth had been better taught than to speak without thinking, and so she said, "An element is all one thing, a thing which is not made up of two things, it is anything which is made only of one substance."

"Yes, that will do," said her uncle. "It is



not exactly how an element is described in books; but it will do very nicely, as it shows that you know exactly what an element is.

"And now, perhaps I had better show you a few elements. There is one," said her 'ncle, as he placed a piece of sulphur on the

table, "and there is another," as he placed a piece of iron on the table. "Out of the sulphur you can get nothing but sulphur, so it is an element; and out of the metal iron you can get nothing else, so that also is an element.

"There are not many elements, and they are not all solid. Some are gases. Of all the gases which are elements, I shall only ask you to remember three: and besides the solid elements which I have shown you, I shall only ask you to remember one. Only six in all; fewer than the rivers which run into the Thames."

Compounds.—"Now, George, it is your turn. What is that?" and his uncle handed him a bright piece of metal something like tin, and as thin as a ribbon.

"I am sure I do not know," said George. "It looks like tin or zinc."

"Well, if it were tin or zinc it would be an element," said Mr. Creswell; "but it is neither the one nor the other. Look," and his uncle held the piece of metal by one end and put the other into the gas-flame. Instantly it caught fire, and burned and blazed with a brilliant and dazzling light. For quite a minute neither Mr. nor Mrs. Hall, nor any

one else in the room, could see clearly, so brilliant had the light been.

"I'll get some of that," said Mary; "what is it, uncle?"

"Well," he replied, "that was magnesium. It is very cheap, and you can get a yard of it for threepence. Many chemists keep it, as do also many shopkeepers who sell fire-

works. I'll give you some, if you come round to my shop to-morrow. But I am afraid you did not keep your eyes open. Do you not see this white substance which I caught on the cover of this book as it fell?"

"What is it?" said Ruth; "I was wondering what it was."

"That is magnesia," replied Mr. Creswell. "It is the white powder mothers at times

buy of the chemists, to give their children when they are unwell. It is a compound, and contains two things. The metal which I burned was an element; but the metal is changed, and is now part of a compound. You have all heard of oxygen. It is a gas, and I will prepare some for you next Thursday if all goes well.

"There is plenty of oxygen gas in the air, and when the metal got hot, the oxygen combined with the metal, forming this white powder. So you see the powder contains both a metal and a gas, and is therefore a compound.

"Water, like air, is partly made of oxygen. Now if I leave my bright bunch of keys on the garden seat during the night, and it happens to rain, they get red with rust. This rust is a compound, and is formed by the oxygen of the water combining with the iron keys. In this case, however, the compound which we call rust is red and not white. Most metals rust, that is, they combine with oxygen; but they do not all rust red or white. Some rust black, and some, like copper, rust green."

"Although we ordinary people say things rust, chemists do not say they rust," broke in Miss Weston. "They say metals oxidise when they combine with oxygen, and they

call the rust an oxide, but as this does not come in the composition of food, you can use the word rust instead."

"Yes, that's right," said Mr. Creswell. "I do not want you to cram any names; but I do want you to see what a compound is. Now, Mary, you tell us what it is. Ruth described an element."

"Well, I suppose a compound is anything every little piece of which is made or composed of two things," said Mary.

"Yes, that will do nicely," exclaimed her uncle; "but you must not say two things. A compound may be made of two elements, like the magnesia and the iron rust; but some compounds are made of three or even more elements. So you must say a compound is a substance composed of two or more elements.

"Now, I think," went on Mr. Creswell, "that you will be able to understand what we mean when we say our foods are compounds. From the magnesia a chemist can get both a metal and a gas, and from iron rust he can get a metal and a gas. In the same way, from our foods a chemist can get several substances, and you now know enough to learn what these substances are."

"Before you explain to the children the

composition of food, would it not be as well to explain what we mean by organic and inorganic?" said Miss Weston to Mr. Creswell. "We shall be sure to use the words, and unless they understand, they are likely to form wrong ideas or possibly no ideas at all."

"Yes, perhaps it would," replied George's uncle. "You know more about children's minds than I do, and the order in which things should come."

Organic and Inorganic.—"Now, George, do you know what I mean when I say London stands on the river Thames?"

"Yes, I think so," replied George.

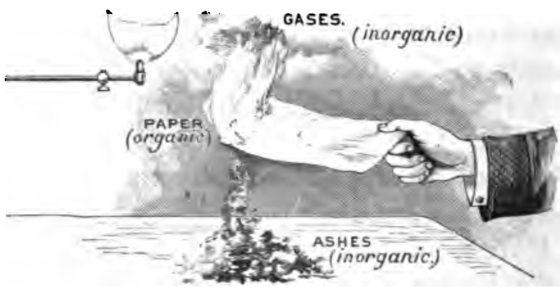
"But does London really stand on the Thames. Does London really stand at all?" again asked his uncle.

"Well, of course," again replied George, "the houses of London stand, but they do not stand on the water; still I know, and every one else knows, what you mean when you say the city stands on the river."

"Very well," said his uncle, "what I am now going to say is not quite exact, but it is as exact as 'London stands on the Thames.' Every part of every animal, and every part of every plant, is organic. Everything which you can get from any animal, such as fat and

glue, is organic; and everything, such as starch and sugar, which you can get from any vegetable is organic. All other things are not organic, and are therefore called inorganic.

"When you burn a leaf, gases pass off into the air and ashes remain. The leaf was organic, but the gases are inorganic and the ashes are inorganic. And it is the same with the wood or the bark or any other part of a tree or plant.



"When you burn a piece of bone, gases pass off into the air and ashes remain. The bone was organic, but the gases are inorganic, and the ashes are inorganic. And it is the same with the flesh, or the skin, or any other part of an animal.

"Animals and vegetables are organic: they have organs whereby they live and feed and

grow. Gases and earth and water are inorganic: they neither live, nor feed, nor grow. And now," continued Mr. Creswell, "I think that will do for to-night."

Two weeks after Mr. Creswell had given Mary, Ruth and George the lesson on elements and compounds, he again put several bottles and powders and acids into his bag, and took them once more around to his sister's house. Both she and Mr. Hall were expecting him, and looked forward to a pleasant and instructive evening.

As Ruth's uncle quite expected that he might damage the table-cloth with his acids, powder and water, he asked his niece to remove it, and to spread some sheets of brown paper on the table. Miss Weston had again come round, as, although she knew all that Mrs. Hall's brother was likely to say, she was not so accustomed to use the chemicals which he was likely to bring.

"Now, Mary," said he, "you remember what I said last time about elements and compounds, do you not?"

"Yes, uncle, I think so," said Mary.

"Very well, as I think so too," he replied,

"I will start at once with the actual composition of food. You remember that oxygen and hydrogen and nitrogen are gases, and that carbon is a solid. Well, if a man had to take down a house, he could tell you how many bricks and stones, and how much iron and wood and slate, had been used in the building.

"So, in the same way, a chemist can take to pieces beef and mutton, bacon and eggs, bread and butter, and potatoes and cabbage, and he can tell you exactly of what each is composed. The builder who took the house to pieces would have so much brick and wood and iron and slate; but he would also have lead and brass and glass and putty, and a host of other things.

"The chemist, however, who took to pieces all the meat in a butcher's shop, all the vegetables in a green-grocer's shop, and all that we buy of the baker and the grocer, would not have so many things as a builder would have in taking down a house. Beyond carbon, oxygen, hydrogen and nitrogen, he would have next to nothing; so that any one learning the composition of food has far less to remember than the builder or his clerk.

"The builder would be able to show you

all the things of which the house was built; but the chemist could not show you all the things he got from the food. He would be able to show you some carbon; but the oxygen, hydrogen and nitrogen, he would not be able to show you, as they are invisible gases. He might catch them, and measure and weigh them; but he could not see them."

"That," broke in Mr. Hall, "is very simple, but I am afraid the children will hardly believe that you can weigh a gas. They will not be able to understand that a thing which you cannot see can have weight."

"Oh, yes, I think they will," answered their uncle. "Now, Ruth, if on a very cold evening you burnt a cwt. of wood in this grate, you know you would burn 112 lbs."

"Yes, I know that, of course, uncle," replied Ruth.

"But suppose, on the next morning, you were to weigh the ashes left in the grate, how many pounds do you think you would get?" asked Mr. Creswell.

Ruth replied that she did not know, and George guessed about five times too much.

"No," said his uncle, "you would not get more than about five pounds; and if you

were to burn a cwt. of straw you would not get more than five pounds. I do not wish you to remember these numbers; but I do wish you to see that most of the wood would pass off into the air as invisible gases, just as the leaf is doing in the picture on page 32.

"The burning of wood and coal and paper happens so often, that people take no notice of it; but were we to burn meat or bread or vegetables it would be very similar. Most of these things also would pass off as gas, and but little would remain.

"Chemists, however, can take to pieces wood and coal and paper without burning them; and they can also take to pieces meat and bread and vegetables without burning them, and they can tell you of what each is made. When foods are taken to pieces, or analysed as they call it, somewhat as we analyse a sentence in grammar, there is very little found except carbon, oxygen, hydrogen and nitrogen.

"I will now prepare some of these for you; but I hope you plainly see that we contain nothing which our food does not contain. If either of us were caught and killed and eaten by a lion, we should be food for the

lion just as though he had caught a sheep or a pig. But the mutton and the pork are made almost entirely of carbon, oxygen, hydrogen and nitrogen. And so we, that is, our flesh, is almost entirely composed of the same four things; and we should be as easily changed into the flesh of the lion, as the mutton or the pork could be changed into ours."

Oxygen.—"Let us start with the gases. Let us take this bottle first. It contains oxygen; but I am not going to tell you how I prepared it, as you have quite enough to remember at your age, without being bothered with the details of my daily work.

"Now, George, watch. I have here a small piece of burnt or rather charred wood, or as we sometimes call it, charcoal or carbon. You see I twist a piece of wire around it, and make it red-hot in the gas-flame. Now I take out the stopper from the bottle and put the hot charcoal into it. There, see how brilliantly it burns. It would have burnt just a little in the air, but in the oxygen it burns far faster and much more brilliantly.

"That is all I am going to do with that

oxygen; and all I want you to notice is that it is gas, that charred wood burns in it very brightly, and that the wood has quite disappeared. Of course you see that oxygen is invisible. You could neither smell it, taste it, nor see it. And yet in spite of this the world itself, and most of the things on it, are largely composed of oxygen.

"Whatever you do, do not forget that the charcoal disappeared when it was burnt by the invisible gas. And now I will empty the bottle, so that that which is in it may come out and mix with the air."

"But if we wanted some oxygen," said Mary, "how should we make it, uncle?"

"Never mind about that," replied Mr. Creswell. "If ever you want to see experiments done, you had better, at any rate at first, go and see them done by those whose business it is to do them. It is very easy to prepare oxygen; but I am not sure that you had not better ask some one else to do it for you."

"May I show them how I, in school, at times prepare oxygen, so that the children may see that it is really a something?" said Miss Weston. Then she took a glass tube and put into it a little black rust—a penny-

worth of black oxide, she called it. This she asked George to hold in the flame of a spirit lamp which she had borrowed from a carpenter, whilst she got a thin piece of fire-wood.

In about three minutes, the heat of the flame drove the oxygen out of the black powder, and out of the tube into the air; then Miss Weston lit the piece of wood in the flame of the lamp, and, as soon as it began to burn well, she blew it out, and put the smouldering end into the glass tube from which the oxygen was escaping.

The moment she did this, the wood, which had almost gone out, burst into a brilliant flame. The three children, as well as their father and mother, could see that heat was driving oxygen out of the black powder, and that the expelled gas was able to cause the wood to burn rapidly.

"Now that is very plain," said Mr. Creswell, "and, if I had thought of it, I would not have taken the trouble I did to bring oxygen here in a bottle. I would have brought the black powder instead, and I would have done exactly what Miss Weston has done."

"I always keep a glass tube and a little

powder," said Ruth's teacher, "and I can always borrow a spirit lamp from one of the parents. So it is always ready, takes very little time and costs really nothing. Now and then I crack a tube, but they have plenty more in the boys' department; and they tell me that they are very cheap, about fourpence a dozen, I think."

"Now, George," said his uncle, when Miss Weston had finished, "you have seen oxygen driven out of a black rust by heat. You remember my burning the magnesium in the air when I had set fire to it in the gas-flame; and you remember the white powder which was formed by the oxygen and the metal. Then oxygen left the air and formed a compound with the metal. Now from a black powder, heat has driven oxygen out into the air.

"Miss Weston has shown you oxygen, which she got from the black rust of a metal; but with the apparatus I have in my chemist's shop, I could prepare oxygen from meat and bread and vegetables. Now, as these things are food for us, if they contain oxygen our food contains oxygen also.

"It is found in the ocean, and it is found in the drop of rain. It is found in the mighty

mountain and in the tiny grain of sand. It is found in every part of every animal, and in every part of every plant. The air is partly composed of it, and there is nothing alive which can exist without it."

Hydrogen.—It was quite a month from the time that Ruth's uncle had shown her and Mary and George the oxygen which he had brought in the bottle, and the oxygen which Miss Weston had prepared from the black powder, before he came again to show them the hydrogen and the nitrogen. He had been very busy in his shop, as his assistant had fallen down the steps into the cellar and seriously hurt his shoulder and arm.

As soon as Mr. Creswell had spread his things on the table and the three children were standing around, "I will prepare," said he, "some hydrogen. Like oxygen it is invisible, and like it, it can be neither smelt nor tasted. Yet, like oxygen, it is found in every living animal and plant, and from every part of every animal and plant a chemist can obtain it."

"It is very easy," went on Ruth's uncle, "to make or prepare hydrogen; but unless I

were accustomed to it I would have nothing to do with it. It is extremely dangerous if it gets mixed with air, and very explosive. But as this is part of my daily work I will prepare some hydrogen for you. There, into this bottle I put some zinc, and over it I pour some spirit of salts, and that is all I have to do."

Through the cork Mr. Creswell had bored a hole, and through this hole he had placed a small glass tube. As soon as he had poured the spirit of salts on the zinc the bottle was filled with bubbles of gas, which came out into the air through the tube fixed in the hole in the cork.

After a while he applied a light to the open end of the tube, and the escaping hydrogen burnt with a pale blue flame.

"There," said George's uncle to him, "that is hydrogen, and as I have already said, it forms part of every animal and every vegetable, and is therefore part of all our animal and vegetable food. It is the lightest thing known, and of it every drop of every river and ocean is largely made.

"If, Miss Weston," said Mr. Creswell, when he had done all he intended to do with the explosive hydrogen, "you wish to show your

pupils hydrogen without running the risk of danger, you can pour some spirit of salts into a cup or saucer and drop some pieces of zinc into it. Bubbles of gas will escape from the liquid, and the gas will be hydrogen; but, were I you, I would not attempt to catch it and burn it, lest the bottle might burst, and some one be seriously hurt.

"And now," continued Mr. Creswell, "we have prepared two of the three gases of which our food is composed, and I will at once prepare the third."

Nitrogen.—Ruth's uncle began by asking her to bring him a large plate and a jug of water. Standing on the table was a bottle or jar which had no bottom, but which had a rather wide mouth, into which was fitted a glass stopper. A cork would have done just as well.

When she had brought the plate and the jug, Mr. Creswell poured some water into the plate, and then stood upright in it a piece of stone about three or four inches high which he had picked up in the street. Then upon the top of the stone, he placed a small piece of phosphorus, and this he took out

of the bottle which is shown in the picture on page 26. "Be careful," said Mr. Creswell, "that you do not touch the phosporous with your fingers: if you do, it will take fire, and you will be severely burnt. You had better take it out with the pointed blade of a knife."

There then stood on the table a plate partly filled with water, in which was standing the stone which had a small piece of phosphorus on the top. Then, taking up the jar, "you see," said Ruth's uncle, "that it contains nothing but air. I place it in the water so that the phosphorus is inside, and I place the stopper on the table."

Mr. Creswell then took an ordinary pen, and, after warming the point in the gas-flame, he passed it down through the mouth of the glass jar, and touched the phosphorus, which was on the top of the stone. Immediately it caught fire, and as soon as he had withdrawn the pen, he closed the neck of the jar with the stopper.

Dense white fumes, resembling smoke, at once filled the jar; and the water began to rise up from the plate on the inside of the glass. Soon the burning of the phosphorus

ceased, and the white smoky-looking fumes gradually settled down into the water.

"There," said Mr. Creswell, "that will do nicely. Now notice that the water has come up a quarter of the height of the jar. Above it is nitrogen; but to look at it you would not know it from ordinary air, as both the nitrogen and the air are invisible."

Lying on the table was a short piece of candle which Mrs. Hall's brother had fastened to a piece of wire. After lighting this candle, he took out the stopper from the bottle, and lowered the burning candle into it. To the surprise of George and his sisters, the candle at once went out, as it did a second time, when, after re-lighting it. his uncle again lowered it into the gas.

"That," said Mr. Creswell, "is nitrogen. As you see, it is a clear, colourless gas. Like the other two gases, you can neither see, nor smell, nor taste it, and yet it forms a part of every animal and every plant.

"Unless it formed a part of our food, we should be unable to grow or live."

Two weeks later, and again on the early-closing Thursday, Mr. Creswell took his bag

over to his sister's. This time, however, he did not take any bottles, nothing but some charcoal, some sulphur, and some phosphorus.

"These are the three things," said he to George, "which, together with the three gases I prepared last time, make up almost entirely every part of the food of all animals and vegetables. So you see there is but very little to remember after all."

Carbon.—"There, that is charcoal," continued Mr. Creswell, as he placed a piece on the table. "It is partly-burnt wood. Except the earthy matter which the tree took up from the soil to harden itself, there is nothing in it but carbon. You have seen me burn a piece of charcoal, and it all passed away as invisible gas. So you see that carbon can exist in a gaseous state in the air.

"Well, plants by their leaves take in this gas, the carbonic acid gas of which we shall speak when we deal with ventilation, and from it they get the carbon they want. And after plants have taken it from the air, we obtain it from them by slowly burning their wood into charcoal.

"You know, of course," said Mr. Creswell to Mary, "that there is not much difference between wood and coal. Coal was once

vegetation, and, when you burn it in a grate, most of it passes up the chimney. The soot which settles on the sides of the chimney is almost entirely carbon. So is the soot on the kettle; and the black on the ceiling, which comes from the burning gas, is carbon also."

"But how can black carbon come out of gas?" asked George. "Why, you cannot even see the gas if it escapes."

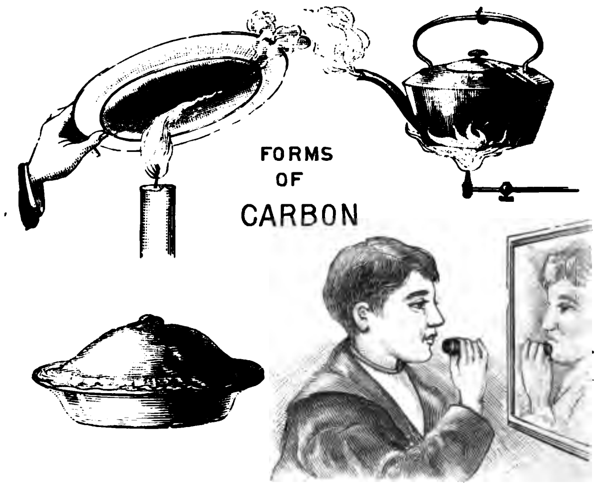
"No, that is quite true," said his uncle; "but it is in the gas for all that, just as it is in the air, from which plants get it. In the gas-works some of the carbon is burnt out of the coal; and the gas is sent round the town in pipes for our use. So, when we burn the gas in our rooms, some of the carbon, owing to our bad gas-burners, is not burned, but settles on the ceiling."

"Last winter," broke in George, "some of the boys in our school had a nigger entertainment, and they blacked their faces with burnt cork. Was that black carbon too?"

"Certainly," replied his uncle. "All wood contains carbon, and so does every part of every leaf and root as well as the bark and fruit and juice. Every part of every plant, and every part of every animal, contains car-

bon. So, as our food is almost entirely animal or vegetable, it contains a great amount of carbon.

"Now, here is an oil lamp. Give me a plate, Ruth." And as soon as she had brought it, he held it over the flame of the lamp.



Instantly the plate became black; and, in that way, their uncle showed them that carbon was contained in oil.

"But you need not wonder at that," explained he. "Look at this candle. It is made of grease, and if I melt the grease it

becomes pretty much like oil. Now I will light it," said Mr. Creswell; and no sooner had he done so, than he held another plate over the flame. Like the oil in the lamp, the candle blackened the plate, so that Mary and Ruth and George could see for themselves that soot—that is, carbon—was contained in the fat of a candle.

"But is that the way in which chemists find out that there is carbon in our foods?" asked Mr. Hall.

"That is one way,' replied Mr. Creswell. "If you get one thing out of another thing it must have been there, that is very certain; and we can get carbon from oil and fat, therefore oil and fat contain carbon. Have you not noticed that, when a joint of meat is overroasted, some of the lean and fat is burnt black?"

"Well," went on his brother-in-law, "that proves that there is carbon in both lean and fat, that is, if the black meat is carbon; and it is."

"But when we burn pie-crust, as we do sometimes when we are not particularly careful," said Mrs. Hall, "is the black crust carbon also?"

"Yes," replied her brother. "Pie-crust is

mostly flour, and flour is largely starch, and starch, like every other food, contains carbon. No matter what food you burn, whether it is meat, bread, flour, or sugar, you get carbon. You must have noticed, when a fruit-pie boils over in the oven, that the sugar of the juice burns black."

"Yes," answered Mary, "and a fine sticky mess it is. It is about as bad as trying to make sweets for ourselves."

"And now," interrupted her uncle, "that we have said all that we need say about carbon, we may as well have a word or two about the other two elements of which our food is partly made. There is not much to be said with regard to them, as all our food is almost entirely composed of carbon, oxygen, hydrogen and nitrogen."

"**Sulphur,**" said Ruth's uncle, "is a mineral. It is obtained from the earth chiefly in those parts of the world where there are volcanoes, and like carbon is an element. There is a little sulphur in every soil, in every animal, and in every plant. As you may have noticed, silver-smiths generally burn their gas outside their shops; this is because the gas contains sulphur which has come from the coal. Sulphur combines easily with silver

and tarnishes it brown, and that is why our silver spoons and forks and cruets turn brown when we keep them in a room in which gas is burnt.

"In the same way if a silver spoon be used in eating an egg, the spoon will be stained brown. This stain is caused by the

sulphur which was in the egg, and which has combined with the silver of the spoon.

"Sulphur is used in many manufactures, and was once used in the making of matches. It is largely used now in disinfecting rooms, as when it is burnt, the sulphur fumes are very destructive to matters which cause disease.

"**Phosphorus,** like sulphur and carbon, is an element, and is found in almost all animals

and in all vegetables. The bones of a skeleton are more than half made of a compound of lime and phosphorus.

"It is a dangerous substance to deal with when it is prepared by chemists. It takes fire with the slightest friction, and for this reason is used in the making of matches. Animals obtain their phosphorus from plants, and plants obtain it from the soil in which they grow.

"And now," continued Mr. Creswell, "this ends all we need know of the chemistry of foods. Most persons, I know, think it is difficult to understand; but I should say, George, that you and your sisters now know a little at any rate, about the *six elements* of which food is chiefly composed."

CLASSES OF FOOD

The next time Mr Creswell came round to see his sister, Mrs. Hall, and the children, he did not bring his bag; as, having already shown them the three gases and the three solids of which our foods, and therefore our bodies, are almost entirely composed, he had, as he said, nothing more to show them.

He, however, clearly explained to them,

that all foods are by doctors and chemists put into classes according to the materials of which they are made. The classes into which he divided them were—

Water
Minerals
Animal Foods
Vegetable Foods.

That water was taken in by the body as food was plain enough to all. They knew that they drank it as water, or in tea, and coffee, and cocoa, and possibly in other drinks as well.

Further than this, they knew that water was used in the making of puddings and pies and bread, and in the boiling of potatoes and vegetables of all kinds; and the three children had no difficulty in seeing that part of this water they took into their bodies as food.

I am not so sure, however, that they quite as plainly saw how they took in the minerals, until their uncle reminded them. Then they remembered the fur or rock which is left on the kettle after hard water has been boiled. Then they also remembered that all plants took up from the soil, part of the earth in which they grew; and that, when they ate the vege-

tables, they ate also the minerals which the plants had so taken up.

"In the soil," said Mr. Creswell, "there are lime and soda and potash and iron. These are generally found, it is true, in very small quantities; and they are found mixed as compounds, with other things. As the plants find them, so they take them up in their sap, and, once up in the sap, they are taken to all parts of the plant to harden it.

"All of these minerals which are taken up from the soil by plants are required by the animals which feed on them. The chief are compounds of lime, and these are mostly used in the formation of bone.

"And now," said Mr. Creswell, "that we know all that is necessary about the uses of water and minerals as food, we may as well see a little further into the uses and composition of animal and vegetable foods."

It is very certain that a person's food does not become a part of his body until it has been completely changed. If it did, the flesh of a person who fed on bacon and pork would resemble that of a pig; and the flesh of a person who fed on beef would resemble that of a bullock or cow. But human flesh differs from pork and beef.

In the same way, if a pig and a fowl were fed on the same kind of food, the flesh of each would be formed from the food it had eaten; but although the food was the same, no one would mistake a chicken for bacon or pork when it was eaten as food.

As from food of the same kind different animals form different kinds of flesh, and, as these meats differ in look and flavour, it is plain that the foods eaten by the animals must be completely changed by them.

What changes actually do take place no one knows, and probably no one ever will know. What happens to food during digestion is well known; but what happens afterwards—how vegetable food can be changed into animal flesh, and how one kind of flesh is changed into another—is not known.

Wonderful as the changes, which go on in our own bodies, may be, whereby beef and mutton and pork are changed into human flesh; they are no more wonderful than the changes which go on amongst the lower animals around us.

Sheep and cows may feed in the same field, and on the same kind of food; but

the mutton will differ from the beef as much as the sheep differs from the cow.

The chief substances found in food are—

STARCH . . . . . SUGAR . . . . . FAT	composed of	Carbon Hydrogen Oxygen	
ALBUMEN . . . . GELATIN . . . . CASEIN . . . . . FIBRIN . . . . . GLUTEN . . . . . LEGUMEN	composed of	Carbon Hydrogen Oxygen	Nitrogen Sulphur

Besides these there are a few others, but these are the chief, and certainly all that any ordinary person might be expected to know. The three on the top of the list contain three elements, and the six below contain the same three, as well as two in addition. "And now for a few words about each of these," said Mrs. Hall's brother.

"**Starch** is found in all vegetables. Flour of all kinds, potatoes, beans, peas and rice are more than half starch, if we take no notice of the water they contain. Starch is of no use to an animal as food, until it is changed into sugar. Sugar is soluble. It can be absorbed through the thin inside skins and thus pass into the blood. Starch, however, is not soluble, and its smallest grains are too

large to pass through into the blood. The saliva and other juices in the body, dissolve the starch grains and change them into soluble sugar.

"I can easily show you that starch is found in flour and potatoes," said Ruth's uncle to her. "Get me a potato and a glass of clean water, and then peel the potato and scrape it so that the pieces fall into the water."

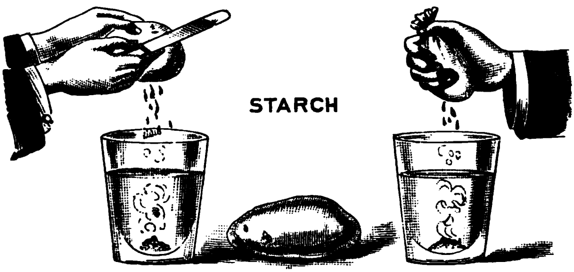
When this was done, Ruth, Mary and George saw the water in the glass turn cloudy. After a few minutes, however, a white powder settled to the bottom of the glass, and this powder, their uncle assured them, was starch.

"And now," said Mr. Creswell, "bring me another glass of water, a fine piece of muslin and a little flour, and I will show you that starch can also be separated from the flour of wheat." So, as soon as Ruth had placed the three things on the table, her uncle tied up a little flour in the muslin and squeezed the bag a few times in the water.

"There," said he, "the water has become cloudy. Stand it on one side, and the starch, which is now floating, will settle to the bottom of the glass. When I again

come round, I, with my microscope, will show you the starch grains both from the potato and the flour.

"Starch is not only obtained from potatoes and wheat; but is found in every vegetable. In addition to the wheat, potatoes, beans, peas and rice, which have been already

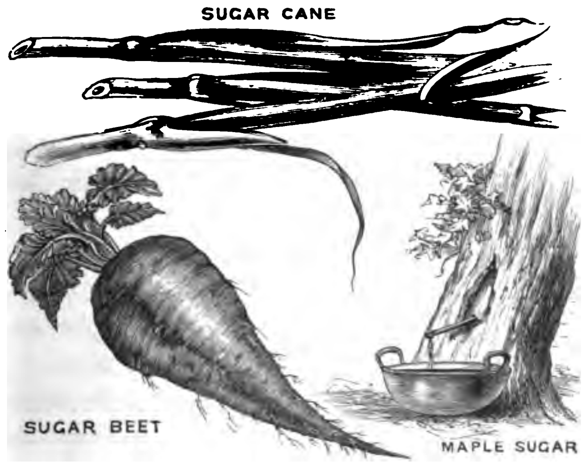


mentioned, starch is largely found in arrow-root, sago and tapioca. Starch is not found in animals except when it is taken as food."

Sugar, like starch, is found in all vegetables; but not in such large quantities. For food, it is obtained from the sugar-cane, the beet-root, and the sugar-maple. These three plants contain more sugar than most other plants;

and in such large quantities as to pay for the expense of manufacture. The sugar-cane and the sugar-maple tree do not grow in this country; and sugar is not obtained from the English beet.

The sugar-cane grows in tropical countries,



much of the English sugar coming from the West Indies. The sap of the canes is sweet, and after it has been squeezed out by machinery, the water is evaporated, leaving the sugar to be prepared by the manufacturer.

The sugar-maple grows in various parts of

the world, but is chiefly used for sugar-making in Canada. The sweet sap is drained away from the tree, and after the water is evaporated, the sugar which remains is prepared much in the same way as cane-sugar is prepared.

The sugar-beet is not grown for manufacture in this country; but in France and Germany whole districts are cropped with it; as beet-sugar is one of their chief articles of manufacture. As in the case of the sugar-cane and the sugar-maple, the sugar-beet is pressed and the sweet juice extracted. After the water has been evaporated, the sugar-makers deal with the beet-sugar very much as they do with that of the cane and the maple. Large quantities are sent to England, where, by most people, cane-sugar, maple-sugar and beet-sugar are unknown from each other.

Although sugar does not exist in many plants in sufficient quantities to pay for manufacture, it does exist in many of our English plants and roots. Carrots and parsnips contain a considerable quantity, and many of our fruits supply us with sugar as food.

Fat, as food, is mostly obtained from animals, but the seeds of all plants contain some. Olives and almonds supply us with much

oil which is really liquid fat; whilst for machinery and many purposes of trade, large quantities of oil are obtained from the seeds of the flax and cotton plants.

Most of the fat, however, which is used as food, is obtained from animals which have been killed, or from milk taken from animals which are still alive. Lard, suet and dripping are fats from our domestic animals; and butter is, or should be, nothing but cream, that is, fat taken from milk.

In addition to the oils and fat which come from plants and animals, large quantities of fat and oil are obtained from the rocks of the earth in various parts of the world. Paraffin, an oil, and vaseline, a fat, are thus obtained; so that fats and oils may be either animal, vegetable, or mineral.

Albumen is found in both animals and plants, so that we have both animal and vegetable albumen. The white of eggs is almost pure albumen.

Gelatine is a jelly-like substance, which can be obtained by boiling the flesh, the bones, and the tendons of animals. It is useful as a food, but not so useful as albumen. As it is very easily digested and absorbed into the blood, it is valuable to persons of weak con-

stitution. Lozenges, and such like sweets, are largely gelatine, as are also the jellies served at dinners and suppers. Glue and size and isinglass are gelatine.

Casein is obtained from milk. When milk curdles, the clot is almost entirely casein and fat. As casein is one of the chief substances in milk, and as casein contains all the elements of which the flesh of an animal is formed, milk must be a good food. Cheese is really compressed curd of milk, and therefore cheese must be a good food also. It is not, however, so perfect a food as milk, as it does not contain the parts of milk, such as the minerals and the sugar, which are dissolved in the water of milk.

Fibrin is found in both animals and plants, and is taken as food both in lean meat and in vegetables.

Gluten also is found both in flesh and in vegetables; but as food, we obtain the greater part of that which we require from the flour of wheat.

Legumen contains more nitrogen than any other vegetable substance. In this part of the world we obtain it chiefly from peas and beans, which grow in pods, or, as they are sometimes called, legumes.

Temperature.—Every one knows that to make good tea the water must be boiling; and to boil eggs properly the water must be boiling also. Unless the water be sufficiently hot, the changes in the tea and the eggs will not take place.

That the heart and the lungs, and other internal parts of the body, may do their work in a proper manner, the body must be kept warm. It must not be made hot, and it may not be allowed to get cold. If the body gets too hot as it does in the case of fever, the person possibly dies; and If, through long exposure to cold air or water, the body gets too cold, the person will probably die. The ordinary temperature of the human body is 98° F.

Before, however, we begin to consider whence the body gets its heat, it will be best to see what heat really is. If we get a good idea of heat, we shall the more easily understand how food causes the body to keep warm.

Until quite recent times, it was supposed that heat was a something which could be given to or taken from a thing. It was thought that when you put your hand on a hot metal, say a tea-pot, the tea-pot actu-

ally gave something to your hand. In the same way it was thought that when you put your warm hand on a cold tea-pot, your hand actually gave something to the tea-pot.

In this way it was considered that when you put a cold turnip weighing a pound into hot water, the turnip became heavier, as it received heat from the water.

Such, however, is not the case. If you rub a metal button on a piece of wood the button becomes warm; and if a blacksmith hammers a piece of cold iron on an anvil the iron becomes warm. In fact, it is quite possible to make a piece of cold iron red hot, simply by hammering it.

If either of you take a hair-pin and hold it lightly by your forefingers and thumbs, keeping your thumbs close together, and then try to break it by bending it to and fro, the metal hairpin will get so hot that you will be unable to hold it.

So in the same way if the wheel of a bicycle or carriage be propped up and made to revolve rapidly, your hand would become quite hot if you were to touch the wheel whilst it was in motion. It is for this reason that sparks fly from the wheels of railway trains, when they are stopping at a station.

Similarly, in the striking of an ordinary match, the match is set alight by the heat of friction between it and the thing against which it is rubbed. When a saw cuts wood both the saw and the wood get warm; and two pieces of wood, or even two hands, rubbed against each other get warm.

It is on this account that forest fires at times break out, where dry limbs are, by the wind, made to rub violently against each other; and it was no doubt owing to this, that savages first thought of rubbing together two pieces of wood to kindle their early fires.

"And now," said Mr. Creswell to his nieces, "you will notice that in every one of these cases of heat there is motion. The button, the hammer, the wheel, the match, and all other small things move. Every one knows that when a thing gets warm it expands. But in expanding all its atoms move, and when they move they must rub each other. Now it is this motion, this rubbing of the little particles, which causes the thing to get warm or hot."

All our foods are compounds, and are made of atoms. When these foods, whether they are animal or vegetable, are taken into the body, they are changed, and sooner or later are burnt by the oxygen which we breathe in by

the lungs. Their atoms move as the atoms of coal move when it is burnt in a grate. They therefore in moving rub each other, and this rubbing or friction causes heat.

It is entirely owing to this burning of our food and of parts of our own bodies by the oxygen, that the heat of the body is caused. By the blood the heat is carried to all parts of the body, and thus all parts of the body are kept warm.

DIGESTION

Now that we have seen that the warmth of the body is kept up by it and our food being burnt by oxygen, it will be well to see what happens to the food in the mouth, the stomach, and the intestines, before it comes into contact with the oxygen taken in by the lungs.

Mouth.—When food, whether it is cooked or raw, is put into the mouth, unless it is a liquid such as milk or soup, it is or should be acted upon by the teeth. In order that every part of the food should be acted upon in the stomach, it must be crushed and made into a pulp, and this pulping or crushing is done by the teeth.

The preparation of the food in the mouth is spoken of as mastication. Whilst in the mouth it is not only rolled about by the tongue and crushed by the teeth, but saliva is also mixed with it. This saliva comes from several glands, two of which any one can see for himself by looking into a mirror, and looking also under the tongue.

From these glands the watery-looking saliva comes, in the same way as tears come from the glands of the eyes. It not only moistens and prepares the food for the stomach; but it also causes changes to take place in the composition of the food itself.

Sugar put into a glass of water, dissolves, but starch would settle at the bottom. Sugar when dissolved, can be absorbed by the skin of the mouth and the stomach and the intestines; but starch cannot be so dissolved.

As every one knows, blood-vessels are found in the outside skin of the body; and they also exist in the thinner inside skin of the mouth and the stomach. Thus it is easily seen that if sugar can be dissolved, it can readily pass through the internal skin and find its way into the blood-vessels. If, however, starch cannot be dissolved, it is equally

plain that it will not pass through, and will not find its way into the blood.

For some time neither Mr. nor Mrs. Hall nor either of the three children had spoken; but at last George broke their long silence by saying, "Then what is the use of eating starchy food if it cannot soak through into the blood?"

"Do not worry over the starch," replied his uncle. "Things do not always remain what they are. You have seen coals change to gases and ashes; and you have seen paper and leaves when they were burnt do the same thing.

"In the mouth the saliva changes starch into sugar, so that what was insoluble becomes soluble. That is all you have to remember about the mouth. In it the food is masticated and mixed with saliva. This saliva changes starch to sugar.

"In this way," went on Mr. Creswell, "the greater part of potatoes and bread is made soluble and ready to pass into the blood."

Stomach.—From the mouth the food passes into the stomach, which is damp and warm and generally in motion. Thus the food is moistened and warmed and kept on the move, and as a result is cooked and rubbed down into a pulp. This pulp is called chyme.

The smaller the particles of food become, the more ready are they to pass into the capillaries which are in the skin of the stomach itself. But this cooking and moving would not succeed in completely dissolving the food, were it not that a juice, which is produced by the stomach itself, is at the same time mixed with it.

This, the gastric juice, appears on the inside skin of the stomach, just as perspiration appears on the outside skin of the body. Both the outside skin of the body and the inside skin of the stomach have glands. Those of the skin are called sweat-glands and those of the stomach gastric-glands. That which comes from the skin is called perspiration, or sweat, and that from the stomach is called the gastric juice.

This gastric juice dissolves the nitrogenous food much as the saliva dissolves the starch; and whilst the food is still in the stomach,

much of that which is dissolved is absorbed into the blood.

Intestines.—After the food has been for some time in the stomach and the nitrogenous food has been dissolved, that which has not been absorbed, passes into the intestines.

If a few globules of fat be skimmed off some soup and shaken up with some water in a bottle, the globules will break up into hundreds of smaller ones, so that the water will look somewhat like milk. If, however, a little soda be put into the bottle the fatty globules will be much more quickly broken up, and they will become as small as they actually are in milk. The same thing takes place when soap is made into a lather or froth in washing.

Starch in the mouth is acted upon by the saliva and is changed. So, too, the nitrogenous foods are in the stomach changed by the gastric juice. The fat, however, in the intestines is not really changed. It passes into the blood-vessels as fat; but the globules have to be made extremely small before they can pass through.

In the bottle the fat was shaken up with water and soda; and the same thing happens to the fat of food in the intestines. There

it is mixed with the water taken at meals, and it is also mixed with bile, a fluid which is made by the liver. As the intestines are continually moving whilst food is in them, the fat and the water and the bile are continually being brought into close contact with each other, and form a white, milky fluid called chyle.

"Now," continued George's uncle, "bile contains soda, and, as a result, the fat globules become very small, small enough to pass through the inside skin and blood-vessels into the blood. Thus we see that

In the *mouth* the saliva changes the starch into sugar.

In the *stomach* the gastric juice dissolves the nitrogenous food.

In the *intestines* the bile and other juices break up the fats into a fine lather or froth.

"By this means," said Mr. Creswell, as he finished for the evening, "most of our food finds its way into the blood, and is carried to all parts of the body for use."

USES OF FOOD

In the preceding chapters we have seen Mr. Creswell, the chemist, and Miss Weston, Ruth Hall's teacher, explaining in a very simple way, and without the use of any hard names, many of the facts connected with food. They had explained to Ruth and Mary and George, as well as to their father and mother, of what their food was composed.

The children had plainly seen that plants were formed from the impurities of the air, that is, of gases found floating in it, as well as from similar gases found in the soil. They had also seen that some of the earthy, mineral matters in the soil had been dissolved, and taken up by plants to harden their stems and twigs and leaves.

And not only had they seen this, but they had as plainly seen that many animals, such as cows and sheep, feed entirely on plants, and therefore were composed of the same things as the plants themselves.

The composition of flesh-eating animals,

such as lions and tigers, was also explained to them; and they were shown to contain nothing which was not to be found in plants. They were proved to be formed of the other animals which they killed and ate; and as these, such as rabbits and deer, were formed from plants; lions, deer, and plants were seen to be made of the same things.

And besides explaining these matters to George and his sisters, their uncle had shown them that the bodies of all animals and plants were made almost entirely of three gases and three minerals. Further, he had shown them that it was by mixtures of these six substances, that all parts of the numberless plants and animals which we see around us were formed, differing though they do in shape, size, smell, colour and taste.

Mr. Creswell well knew that his nephew and nieces quite understood these things, when, with Miss Weston, he gave them another lesson on the uses of food in the body.

"You remember," said he to George, "that all foods must be water, minerals, animals, or plants, or mixtures of them, do you not?"

"Yes, I think so," said George.

"Well, for a lesson or two we will say

nothing about actual water and minerals," continued his uncle, "but we will confine ourselves to animals and plants.

"Food, as you know, has more than one use in the body. It has

To Supply Heat.
To Make us Grow.
To Replace that which we Lose.

In addition, the food has to supply energy or force to enable the body to work. A steam-engine will not work until its food, the coal, is put into it to make the water hot; and, in the same way, our food warms our blood, and enables us to move and work.

"The most important, however, of these uses is, no doubt, the supplying of heat, for if the body got cold, or even very cool, we should certainly die, whether we were starving or not. You have heard, I suppose, of persons being frozen to death?"

"Yes, of several cases," said Mary. "Last winter, in Cornwall, a postman in crossing a moor fell, or rather slipped, into a shallow pit. As he hurt his leg so that he could not get out, he became so cold that his heart stopped beating and he died."

"I did not know of that case," said her

uncle, "but there are hundreds of well-known cases where people have died of cold. In the Arctic regions, amidst the ice and snow of winter, it is no uncommon thing for men, in spite of their fur garments, to be frozen to death.

"The body, that is, the internal parts and the skin, can stand a great deal of cold; but the heart will not work if the blood loses too much heat; and I need hardly tell you," went on Mr. Creswell, "that if the heart stops, the blood ceases to flow. As a result, the lungs and the other internal organs stop also, and death is the instant result.

"And not only must the blood not be allowed to get too cold. It must not be allowed to get too warm; in that case also the heart will not work, and that is why persons die of fever. Too much heat and too much cold are equally dangerous."

"What have heat and cold got to do with food?" said Mr. Hall.

"Well, a great deal," replied his brother-in-law. "We have already had an evening on heat, and you will remember that when parts of anything move in contracting or

expanding there must be heat on account of the friction. When food is put into the body it is completely taken to pieces. This alone would cause some heat; but the food is burnt as well.

"Knowing that it would be easier for you to understand this matter if you knew what happens to the food in the mouth, the stomach, and the intestines, I explained to you all, in a simple way, what took place in digestion.

"Further than that, I explained to you how the blood flowed from one part of the body to the other. Of course the blood in the skin would get colder than that in the inside organs. But the blood does not stay in the skin: it flows to the inside organs as well, so that, although the blood near the outside is always losing heat, it gets more from inside."

"But if that be so, the body in time must get quite cold," said Mrs. Hall.

"I am afraid," replied her brother, "that you must have been getting the supper when we were last speaking of this. No doubt if it were all loss the body would get cold; but it is not all loss. There is continual gain. The food we eat is continually being burnt,

and therefore we are continually being made warm.

"Oxygen burns our food as surely as it burns the coal in the grate, and heat is the result."

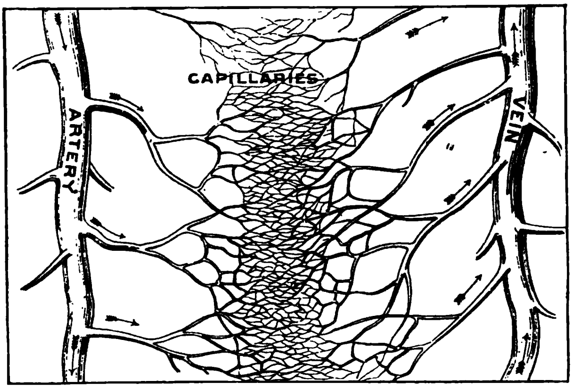
"I think we know all that," broke in Ruth, "but I do not think we quite see where the burning takes place."

"You do not see where the fireplace is, is that it?" said her uncle. "Perhaps not; but although there is no one fireplace inside, the burning takes place for all that. The blood, as you know, takes in the food very finely divided, so fine as to be dissolved and absorbed into the very thin blood-vessels. There, in them, the food is burnt. Oxygen finds its way into the blood through the lungs, and both it and the food swim or float, or are carried along together in close contact with each other.

"There, in the little blood-vessels, the smaller particles of food are burnt by the still smaller atoms of oxygen; and it is in this way that the heat is caused. There is no one place in which the food is burnt. The burning takes place wherever there is blood, that is, if there is any food in it to burn. There is sure to be plenty of oxygen,

as a person cannot help breathing. He may, however, be unable to take in food. He may be ill, or he may be starving.

"When a person takes no food there is nothing in his blood for the oxygen to burn. It then burns him instead, and, as



he slowly burns away, he gets thin and dies.

"And now that we have again gone over the warming of the blood, you will see how foods differ in their power of keeping up our temperature.

"You all know that coals are not all the same price, neither are they all equally good.

Some come from one part of the country, and some from another. Some throw out much heat, and some but a little. Some leave much ash in the grate, and some next to none.

"Well, foods differ in the same way. All animal and vegetable foods, as you will remember, contain carbon, hydrogen, and oxygen; but they do not all contain the same quantity of each. Starch contains carbon, hydrogen, and oxygen, and fat contains the same three things. If starch and fat contained the same quantities of carbon and hydrogen and oxygen, they would give also the same amount of heat when they were burned."

"But no one burns starch," said Ruth.

"Oh, yes, they do," replied Mr. Creswell; "they burn wood, and wood contains starch. If you burn anything, no matter what, you get some heat; but if you burn a pound of starch and a pound of fat, you get about twice as much heat from the fat as you do from the starch. This can be easily proved.

"So, in the same way, if I eat a pound of starchy food, say rice, and it is burnt in my blood-vessels, I get a certain amount of warmth. If, however, I eat a pound of fat,

I get from it about twice as much heat. This also can be easily proved.

"This extra heat is due to the carbon. There is twice as much carbon in fat as there is in starch, and the more the carbon the more the heat. Therefore, if a person were in danger of dying from cold, he should eat foods which contain much carbon. As fat contains more than rice, which is mostly starch, he should prefer fat to rice."

"As I have already said," continued Ruth's uncle, "all animal and vegetable foods contain carbon, therefore all foods when they are burnt by the oxygen give us heat. But as foods differ in the amount of carbon which they contain, they differ also in their power of keeping us warm.

"It is for this reason that a Greenlander prefers fat as food. He may not know why, but he does know that it helps to keep him warm.

"In the same way a Hindoo prefers his rice. Rice, it is true, contains carbon, but it contains less than fat. As a result, a Hindoo by custom takes his rice. He knows that fat would cause him to be too warm, and he already has

enough warmth from the tropical sun. His object is to keep cool, and not warm.

"The Hindoo may no more know why he prefers one food to another than the Greenlander does. Neither the one nor the other probably troubles himself about the why and the wherefore, the science of his life. What he does he does from habit, simply because his

forefathers have done the same; and they, no doubt, by painful experience had learnt to eat and to do that which suited them best.

"Of course, both the Hindoo and the Greenlander consider not only the heat caused by their food within their bodies. They also consider the loss of heat from the outside skin of their bodies. In the case of the Hindoo

he is only too glad to allow the heat of the body to escape, as he lives in a clime where the sun warms not only him, but all things around him.

"The Greenlander, on the other hand, gets but little or no heat in the winter from the sun. Thus he is only too glad to preserve the heat he obtains from his food; and, as a result, he wraps himself in skins and furs, which do not easily allow it to pass away."

The same thing applies to the people of this country. In the winter we are glad to keep in the heat of the body, that is, the heat we get from the combustion or burning of our food by the oxygen.

In the summer, however, that is, during the seven or eight weeks of the year during which it is warm, we in this country go lightly clad. The thin things we then wear screen us from the direct rays of the sun, and at the same time permit the heat of the body to escape.

Not only do we get heat from the burning of the carbon in our food, we get heat also from the burning of the hydrogen and other matters. Carbon, however, gives out most heat when it is burnt, and that is why those who are fond of putting everything into some class or other, place fats first in the list of

what they are pleased to call the heat-producing class of foods.

Starch and sugars are also placed in the same class, as, although they do not contain so much carbon as fats and oils, they do contain a great deal. As will be seen from p. 56, fat, oil, starch, and sugar do not contain nitrogen. Carbon is the chief thing which they contain, and it is for this reason that they are classed as

Carbonaceous foods,

and it is because the burning of their carbon gives rise to much heat that they are also called

Heat-producers.

"And now," broke in Miss Weston, "I think we ought to tell the children that *these names are very misleading*, unless we fully understand what we mean by them. One might be led to suppose that all the carbon we take as food comes from fat, oil, starch and sugar; but this is by no means the case.

"We get carbon from all our animal and vegetable foods, but we get most from those just mentioned. Neither of the four foods contains nitrogen, and it would be far better to speak of them as

Non-nitrogenous foods,

as they are now generally called by medical men."

Those foods named on p. 56 which do contain nitrogen contain carbon also, and, when they are burnt in our blood, do give out heat. Therefore they also are carbonaceous and heat-producers.

Although all animal and vegetable foods produce heat, the chief heat-producers are classed below, together with the actual foods from which the fat, the oil, the starch, and the sugar are obtained; but it must not be forgotten that *heat is obtained from the burning of all foods*, and it should be noticed that the fats named are all obtained from animals, although a little is obtained from some vegetables.

CHIEF HEAT-PRODUCERS

Fats	Butter, cream, cheese, lard, fat meat.
Oil	Olive-oil, almond-oil, cod-liver oil.
Starch . . .	Rice, flour of all kinds, arrowroot, sago, potatoes.
Sugar . . .	Sugar-cane, sugar-beet, sugar-maple, fruit.

It was three weeks after Ruth's uncle had given them such a long evening on the heat-producing foods, before he was able to spend

another evening with his sister and her family. As before, Miss Weston was there. During the day Mr. Creswell had sent her a note, and among other things, he had asked her to run round.

"Are you not getting tired of food?" said George's uncle to him, as soon as they sat round the table for their usual chat.

Chief Heat-producers.

"No, I do not think so," replied George. "Of course, uncle, I know what you mean; but I am neither tired of the food I get to eat, nor of the talking about it. I thought from what Mary had said that it was going to be very dry; but although it is not so pleasant as a circus, I like it better than grammar."

"That's all very well," interrupted Mary. "When I was learning about foods in school, we had to get it up from books, and they

were so hard that we could scarcely understand them. And besides, they were full of tables of names and figures. Uncle Alfred has not bothered you with all that. If he had, I expect you would often have gone to sleep, as you did at the Institute."

"No, never mind a lot of names and numbers," said Mary's uncle. "I do not mind as long as you understand what we are talking about.

"Last time, I was explaining to you how the heat of the body was caused and the temperature kept up. You will remember that some foods contain nitrogen and that some do not; and I told you that it would be well to speak of those which do not as non-nitrogenous foods."

Tissue-Formers.—Those foods which do contain nitrogen are often spoken of as tissue or muscle formers, because, unless we took in nitrogen as food, our bodies would not only cease to grow, but we should waste away and die. The fat of our bodies does not contain nitrogen, but our muscles and all other parts do.

It must not be supposed, however, that our muscles are formed of nitrogenous food only. All kinds of experiments have been tried in

feeding and fattening animals, both in this country and abroad, and it is certain that no one food is used in forming any one part of the body.

Lean meat is a nitrogenous food. Our muscles, that is, our lean meat, are not, however, entirely formed of lean meat taken as food. All our foods, fats, starches, and nitrogenous foods alike take part in building our muscles.

In the same way the fat of an animal is not entirely formed of fat taken by it as food. A pig fed entirely on barley-meal or flour will grow and get fat, therefore the lean and the fat must be formed from the barley-meal. How this is done no one understands, and probably never will, but it is none the less a fact.

It must not be supposed, however, that the meat is all changed to fat. Not only is fat formed in the pig; its lean, and skin, and bone,

and hair are also formed, so that the one thing, meal, is changed into many things in the animal.

And it is the same with us. From bread, that is, flour or meal, fat, and lean, and bone, and skin, and other things as well are formed in our bodies; so that, as in the case of the pig, the one thing, flour, can be changed into many things in us. And what is true of bread is true also of potatoes and meat and all other foods. In us they are changed and help to form the various parts of our bodies.

But although fats and starch and sugar taken as food can help to form all parts of us, they cannot by themselves form all parts of us. They contain no nitrogen, and therefore they cannot form our muscles, although they may and do help to do so.

Nitrogenous foods, however, can by themselves form muscle, and as they contain the three things required to form fat, they can also help to form the fat as well as the lean of our bodies. It is for this reason that foods which contain nitrogen are called tissue-formers, but it must be remembered that all foods take part in the work.

"Why do they speak of tissues when they are speaking of muscles and fat and skin?"

asked Ruth. "I have heard of a tissue of falsehoods, but never of a tissue of meat."

"That is right," replied her uncle. "Always ask when you do not know. You are something like the clever Persian. When asked how it was he knew so much, he replied, 'Because I was never too proud to ask when I did not know.'

"A falsehood is one thing, but a tissue of falsehoods consists of many woven together, and so tangled up that it is difficult to take them to pieces to get at the truth. In the same way, a tissue is a thing so made as not to be easily taken to pieces. We have muscular tissue, fatty tissue, bony tissue and so on, in which the atoms are so woven together as not to be easily separated except by a chemist."

The following is a list of the chief nitrogenous substances, together with the foods from which they are chiefly obtained :—

CHIEF TISSUE-FORMERS

Albumen	Lean meat and white of egg.
Fibrin	Lean meat and vegetables.
Casein	Cheese and milk.
Legumin	Beans and peas.
Gluten	Wheat.

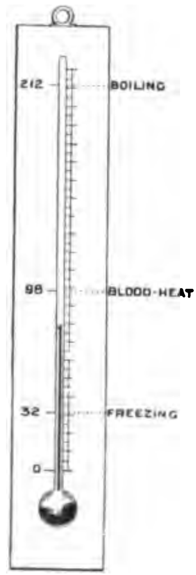
These are the chief tissue-formers, and they are mostly obtained from the foods named on the right, but in lesser quantities they are found in other foods as well. Gelatine also contains nitrogen, but it probably takes no part in the formation of flesh. When cold it is solid; but when it is as warm as the body it is a liquid, and thus, at any rate by

Chief Tissue-formers.

itself, it can hardly form part of the muscles of our bodies.

Thermometer.—A few days after Mr. Creswell had finished all he had to tell his nephew and nieces about the uses, or, as they are sometimes called, the functions of food, George had to fetch some tooth-powder from his uncle's shop.

During the many lessons he had had on the heat obtained from foods and on the temperature of the body, his uncle never for a moment thought it necessary to explain exactly what a thermometer was or how it was made. George of course knew it told us whether one thing was warmer than another, but beyond that he knew nothing of it.



It so happened, however, that there were several lying on the counter, and George had no sooner taken up one to look at it, than he dropped it on the floor and broke it.

"That is very clumsy of you," said his uncle. "That is a shilling lost. But now that you have broken it you may as well look at the glass tube."

Then for the first time George saw how a thermometer was made. He saw that it was simply a long glass tube blown out into a bulb at one end and closed at the other.

This tube had been fastened to a piece of

wood, and *freezing* and *boiling* had been printed on the wood alongside the tube.

"How do the makers know where to print the words," asked George; "and how do they know where to put the black strokes between?"

"That is easy enough," replied his uncle. "In the first place, the glass tube is empty. At one end there was the bulb, but the other end was not closed. Those who make thermometers partly fill them with either mercury or coloured alcohol, which is spirit of wine.

"When they have done this, they hold the bulb in some water in which some lumps of ice are melting. This water is ice-cold, and when the mercury or alcohol has come to rest, they put a scratch on the glass to show the height at which freezing is to be marked on the wooden part of the thermometer.

"The bulb is then placed in a vessel of boiling water, when the mercury or alcohol at once begins to rise in the tube and continues to do so until it gets as hot as the water. It then stops rising and comes to rest, when another scratch is placed on the tube to show how high *boiling* is to be marked on the wood, when it is attached to the glass tube.

"Now notice that the mercury stands at 60°," said Mr. Creswell. "When the air is about as warm as it is to-day it is comfortable; and if possible our homes should be kept at this temperature.

"At times the mercury runs down many degrees below the freezing-point, and then we say we have so many degrees of frost. Sometimes here in this country in the summer it runs up to 120° in the sunshine, and at times it stands as high as 85° in the shade. Then it is too warm to do much hard work."

"This thermometer, I see," said George, "has no mercury in it. Is this red liquid the spirit of wine?"

"Yes," replied his uncle, "that is alcohol."

"Why do they not use coloured water?" again asked George; "would it not be cheaper?"

"Yes, it would be a little cheaper," said Mr. Creswell, "but water would not do. With cold it would freeze and burst the glass. Alcohol, however, does not freeze with ordinary cold, and that is why it is used for thermometers."

ANIMAL FOOD

Meat is the name generally given to the flesh of animals which are used as food. The flesh of fowls and ducks and such-like animals is not in trade called meat, but comes under the head of poultry. Neither is the flesh of fish spoken of as meat, but simply as fish.

The chief animals which come into the hands and shop of the butcher as food are the ox, the sheep, and the pig, as well as the young ox and the young sheep, which we speak of as calves and lambs.

The flesh of the ox and cow, as every one knows, is beef, that of the sheep is mutton, and that of the pig pork, whilst that of the calf is called veal and the flesh of the lamb, lamb.

These meats or foods are all composed of the same things, but they are not exactly alike for all that, as they differ in look and flavour as well as in the good they do the person eating them. And besides this, all persons cannot eat each of them equally well. Some persons cannot touch veal, and some cannot with comfort eat pork, whilst mutton and beef do not agree with all.

And, in addition to this, all parts of the

same animal do not equally well agree with the same person. A man may with pleasure partake of leg of mutton, but he might be made actually ill with the shoulder. And it is the same with various parts of other animals. Some agree with the persons who eat them and do good, whilst others upset and do no good to the persons eating them.

Besides the animals already mentioned, the flesh of others is often used as food in various parts of the world. Rabbits and hares and deer are used here, whilst the flesh of many wild animals is used abroad.

Not only do the various foods in daily use among us, differ in their flavours and action on our inside organs; but they actually differ in their value to us as food. Some contain more nitrogen than others; and some contain more carbon, and, as a consequence, they do not all do the same work in us when we eat them as food.

Beef and mutton and pork do not differ much in their composition, but they do differ nevertheless; and little differences in them make great differences in us. But taking 100 lbs. of raw butcher's meat altogether, it contains the following substances, in about the following quantities:—

100 lbs. Raw Meat

Water	74
Minerals	2
Fat	4
Nitrogenous Food	20
	100

These numbers are not meant to show that all beef, mutton, and pork contain these matters in exactly the same proportions. All meat is not equally fat, and the other substances vary as well; but, speaking generally, the figures give a good idea of the usual composition of meat.

And not only does beef differ a little from mutton and pork, and not only do these differ between themselves, but the flesh of one ox is not exactly like the flesh of another ox. And in the same way the flesh of two sheep would differ, and that of two pigs would differ. Still, as has already been said, the difference is not great; and one piece of meat is pretty nearly the same as another as far as its composition is concerned.

But it is these little variations which make one kind of meat more useful than another to persons who are not fully grown, and to

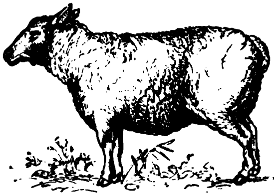
those who are not well. Beef contains more nitrogen than mutton, but mutton contains more minerals than beef.

As a result of this, beef would be a better food for a man whose muscles were wasting away than mutton; but for a child, whose bones were not being properly hardened, mutton would be better than beef.

Beef, as already stated, is the flesh or the muscle of the ox or the cow. It varies a little in composition and in toughness and flavour with the breed of the animal, with its age and with the kind of food which has been supplied to the ox or the cow, from whose body or carcass it is taken.

For ages past beef has been the favourite animal food of the English nation. As a rule, the Englishman works hard, and beef better keeps up his muscles and strength than any other meat. In the same way beef-tea is more strengthening than mutton-broth, as far as the muscles of the person taking it are concerned.

Mutton is the flesh of the sheep, and, like beef, is used as food in almost all parts of the world. It was used by the Ancient Briton, and it is used by us to-day, and it is used in our colonies all over the world. Man's earliest wealth consisted of his flocks and herds; but to feed the nations of to-day, far more sheep are reared than were kept in the olden time.

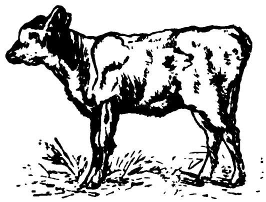


Mutton is not so useful as beef in forming the flesh of men and women; but, as it contains more of the bone-hardening substances, it is far more useful to crooked-legged and weak-boned children than beef.

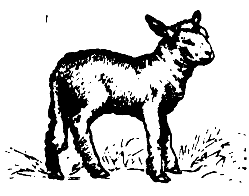
Pork is the flesh of the pig, and, as a rule, contains more fat than either mutton or beef. No animal can be much dirtier in its habits or eat more dirty food than the pig; and yet there are but few animals whose flesh is so savoury or tasty. Mutton is mutton and beef is beef from whatever

part of the animal it comes; but from the pig we get ham and bacon and pork. The word ham is applied to its two hind-legs, bacon is the name given to its sides and body, and pork is used for the flesh as a whole.

Veal is the name given to the flesh of the calf. In colour it is lighter than beef, as, when a calf is killed, much of the blood is allowed to drain away from the carcass. As a food, veal is not so nourishing as beef; but as it is generally more tender, it is often useful to persons who are ill or who are recovering from an illness.



Lamb is the flesh of the lamb or young sheep. Like veal, it also is not so nourishing as the flesh of the older animals. It is, however, more tender and comes as a welcome change, as well as being a means of tempting the appetite of the invalid.



All lean meat should be not only carefully cooked, to prevent the strengthening juices

from running out, but it should always be thoroughly cooked to prevent germs of disease from doing us harm. Many kinds of minute life exist in the bodies of the lower animals, and they can live equally well in us.

Our teeth and the juices of the stomach do not always destroy these little creatures; but heat does. By thoroughly cooking the meat you thoroughly cook and kill these small causes of mischief. Underdone meat, especially that of pigs and ducks, is likely to do much harm in this way.

Preserved Meat.—Tinned meat is that which has been closed to the air somewhat in the same way as we keep our jams and pickles from the air. There can be no doubt that foods of all kinds, both animal and vegetable, do not last long if they are exposed to the air. Fish and meat and cheese soon decay; and all decay is most likely caused by the destruction of the food by minute germs and minute living animals and plants, of which crowds exist in the air.

If an apple be cut in two, and the two halves be at once placed under the cover of, say, a glass butter-dish, to keep them from the air, the cut faces will, in a few days, be covered with coloured, growing vegetables

and animals, which settled on them whilst they were for a moment exposed to the air. The mould on jam and on old damp boots is caused in a similar manner.

In the same way meat and fish are destroyed by these minute animals and vegetables, which feed on them. The warmer the weather, the more rapidly do they increase and multiply, and therefore the more rapidly do they destroy that on which they have settled.

In the same way, cuts and scalds and burns are made worse if they are left exposed to the air. Crowds of these destroyers settle on the wound, and feed on the flesh which has been hurt and exposed.

It is to prevent this that ointments and bandages are applied to wounds. By this means the air and its contents are kept away, and the ointment not only acts as a cover to the wound, but helps to destroy the small things which were feeding on it.

Bandages and ointments, however, cannot be used to protect our food. Dry food, such as flour, is not much affected, but on damp things, such as meat and fish, the microscopic life of the air feeds as soon as it falls on them. But, as has been already said, the warmer the weather the more rapidly do they act, and,

knowing this, the butcher then keeps his meat in a cool room, and the fishmonger obtains the same result with lumps of ice placed amongst his fish.

The tinned meats which are sold in this country are prepared in foreign lands, where the people are few and the cattle are many.

There the best pieces are placed in tins, and the covers, which have a small hole in them, are securely fixed.

After this is done the tins are stood in a shallow pan of boiling water, so that the meat in the tin is thoroughly boiled, and all the life which may have entered with the air is killed. As the steam comes out by the hole left for

the purpose, all air is driven out with it; and, before more air can enter, the hole is soldered over and the meat is secured in an air-tight tin.

In addition, however, to the meat preserved in tins, great quantities of meat come to us from foreign lands exactly as the butcher left it. It is not even cut up into joints, but the carcasses are hung in rooms in a ship, as you see them hung in the shop of the butcher. In these rooms, and hung exposed to the air, the meat is brought for thousands of miles, even across those parts of the world where it is extremely hot.

The air, however, of these meat-rooms is kept cool, so cool that the animal life in the air cannot feed on the meat around them. Meat thus kept cool can be kept long.

In some cold countries meat is kept through the winter without being preserved in any way. It is simply kept out of doors in the frost. There the people have nothing to do but to saw off as much as they want, as they saw off wood when they want it.

MILK

Milk is used as food in all countries where milk-giving animals can be kept, and it has been so used in all ages and in all climes. It is a perfect food in a perfect form. It contains all that animals which feed on it require;

and it is in such a form that it can be taken in and used by the animal without preparation by cooking, and without much preparation by the internal organs of the body.

It is on account of this that all young animals which take milk, live entirely on it for some time after they are born. Calves

and lambs, dogs and cats, and all such-like animals, in their early days take nothing but milk; and this should be a lesson to parents not to feed their children with anything else until they are a few months old.

After a time, however, calves and lambs, and dogs and cats, and lions and tigers, feed on other things as well; but this is not until the glands of the mouth, the stomach, and the intestines are able to prepare the saliva and the other matters which change insoluble foods and make them soluble.

Children, however, often have much harm done to them by their parents and nurses feeding them with bread and potatoes and similar foods, before their internal organs are able to act upon them. These are unable for some six months to prepare the saliva and other matters which are required; and, therefore, to feed children with other foods than milk before that age, is to put into them food of which they can make no use.

That milk is a perfect food there can be no manner of doubt. A baby when three months old generally weighs about six pounds, and when six months old weighs about nine pounds. So it is perfectly certain that the

materials from which its fat and lean and bone and skin and other parts are made, must have been contained in the milk if the child has been fed entirely on it.

Thus milk contains bone-forming material as well as that which can form fat and flesh. Milk can therefore be said to contain tissue-forming foods. But not only does it contain these: it contains heat-producing food as well. It is true that a baby would not live long if it were fully exposed to the cold; but a baby wrapped up in warm garments, itself supplies the heat which keeps him warm. The warm garments merely prevent the heat from escaping, and they too become warm; but the heat comes from the body and the milk taken as food.

When, however, we call these foods heat-producers and tissue-formers, it must not be forgotten that all foods cause heat, and that all foods help to make tissue. This was explained in the chapter on food on page 83. The names are badly chosen, but they are the ones usually employed, and therefore have to be used here.

From the following table a general idea of the composition of both milk and butter may be obtained. On the left may be seen

the materials found in each, whilst the few numbers given show of what each is chiefly composed :—

	Milk.	Butter.
Water	**87**	**10**
Fat	**4**	**87**
Sugar / **Nitrogenous Matters** / **Minerals**	9	3
	100	100

Thus of 100 lbs. of milk 87 are water, whilst of 100 lbs. of butter 87 are fat. Beyond these two substances, water and fat, there is not much in milk and very little in butter. The milk from any one cow is not exactly like the milk from any other cow; neither is the milk from one breed of cows exactly like that from another breed. Butters also differ, but the differences are slight. People all over the world vary. Hindoos and Chinese and British vary, but they are nearly alike in spite of the differences.

Condensed Milk is ordinary milk from which much of the water has been evaporated, and to which sugar has been added.

It is preserved in air-tight tins, much in the same way as tinned meat is preserved. As in the case of meat, the milk in the tins is made hot, so as to destroy any germs or minute life which may be in it. After this the tins are perfectly closed and the milk kept perfectly pure.

Cream is fat and is found in all milk. This fat exists as very minute globes, or, as they are called, globules. It would take some 2000 of them to make an inch. These fatty particles float in the milk; but if the milk be kept still, a great number of them float on the top. As corks thrown into water float, because they are lighter than water, so the fat globules float because they are lighter than the water of the milk.

When the fat rises to the surface of the milk simply through the standing of the milk, we get raw cream; but when the milk is warmed, more fat rises to the top, and we get what is called clotted cream.

Butter is cream which has been churned. A churn is simply a barrel into which the cream put, and in which it is kept continually

tumbled about for half-an-hour. During this turning and tumbling much of the milky part of the cream is drawn off. After the fat which is left has been washed it is called butter.

Cheese.—When milk turns sour, as it is called, it separates into a watery part and curd. This curd contains the fat and what is called the casein of milk. When milk is taken into the stomach of an animal or person, the acid juice of the stomach curdles it, that is,

without turning it sour, it at once separates the curd from the water or whey.

A few drops of anything sour or acid, such as vinegar, will curdle milk. Milk poured over the sour juice of a pie, curdles; and

cheese-makers curdle large quantities of milk in somewhat the same way.

Into it they pour a sour liquid which they make for the purpose. The curd at once separates from the whey, and after the water

is drained away, the curd is by salting and pressing and drying made into cheese.

Thus it will be seen that, as cheese contains not only the casein but the fat of milk, it is a useful food for all purposes. It helps to form flesh and it helps to supply warmth. Cheeses, like all other things, differ in taste and appearance and quality and price; but these differences depend on the customs of those who make them.

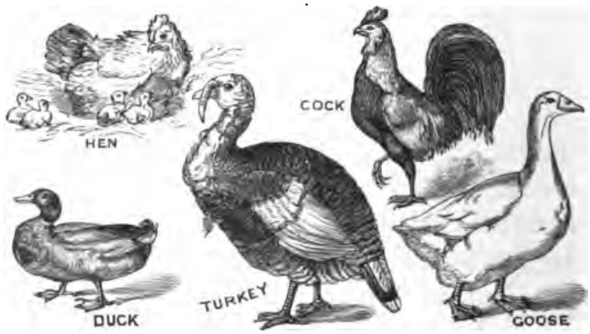
Eggs, like milk, contain all that is needed for the growth of an animal. A chicken is an animal, and its bones and flesh and fat and skin and feathers have all been made from the egg. But an egg is not so perfect a food for us as milk, as it does not contain the things we want in suitable proportions. There is not enough sugar and there is not enough water.

The eggs of all birds, as far as what they contain is concerned, are good for food, but they are not all equally nice. In this country we eat the eggs of fowls, ducks and turkeys, but not many of those laid by other birds.

The shell of an egg is formed of carbonate of lime, and this the bird gets from the food

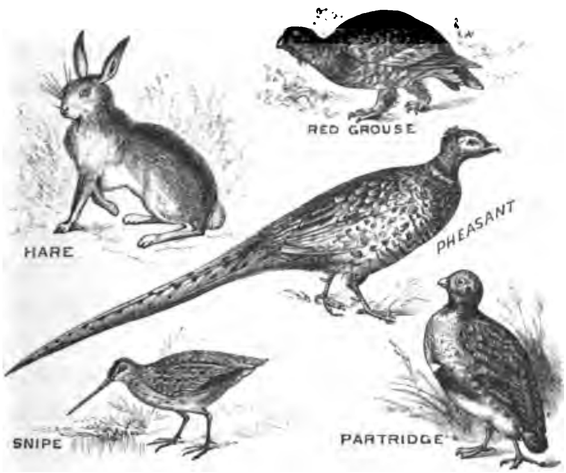
it eats and the water it drinks. The shells of oysters, and of most other so-called shell-fish, are formed of the same material; and this also is obtained by them from the food and the water which they take, in much the same way as we get the mineral matter for our bones from the food we eat and the water we drink.

The greater part of an egg is albumen.



When an egg is uncooked this is partly liquid, which is more or less thick, like gum. This albumen, when an egg is placed in hot water, becomes solid and white. It is extremely useful as a food, as it contains all the materials of which it is said to be composed on page 56. It thus helps to form our bodies as well as to supply us with heat.

In addition to the white of the egg there is also the yolk. This is generally yellow, and weighs about half as much as the white. The yolk contains fat in addition to albumen, and bone-forming minerals are found in all parts of an egg.



Poultry is the name given to all kinds of domestic birds which are used as food. It includes fowls, ducks, geese and turkeys. Wild fowls and birds are not strictly poultry, but come under the head of game. The composition of the flesh of poultry is much the

same as that of beef and mutton; but. as a general rule, the flesh of fowls, ducks, geese and turkeys takes longer to digest than meat we get from the butcher. The flesh of fowls and turkeys contains less fat than that of ducks and geese; and fat, generally bacon or ham, is eaten with the flesh of the former.

Game is the name given to all wild animals which are killed for food. Pheasants, partridges, hares and similar animals are game. The flesh contains about the same amount of nutriment as that of poultry, and is specially useful in cases of illness, as appetite and digestion are greatly helped by variety.

FISH

Fish at all times, has formed one of the chief articles of food amongst those who have lived near the sea. Man in the early ages was a fisher as well as a hunter, and caught and ate not only the fish which lived in the sea, but those which lived in rivers and lakes as well.

Now, however, each man does not catch or grow the food which he wants for himself and his family. Others catch or rear or grow food for him; and thus we have farmers and

gardeners and fishermen in all parts of the world, whose trade it is to find food for others as well as for themselves.

As a result of this change in the customs of people, those who live far from the sea can in a few hours have brought to them fish which they would otherwise never see; whilst people in any one part of the world can, in the course of a few weeks, have brought to them across the sea, fruits and food of all kinds of which they would otherwise never hear.

As a food, fish contains all the substances of which our bodies are formed. All the things found in meat are found also in fish; but fish is no more a perfect food for man than either mutton or beef. With other things, such as bread, fruits and vegetables, fish supplies to man all that he needs, so that he can do entirely without meat, as many of his forefathers had to do.

At the present day, however, fish is taken by many people, especially by the well-to-do, more as a luxury than as a food. But for all that, it takes its part, not only in adding to our tissues, but also in supplying warmth, and in helping the various parts of the body to do the work they have to do.

Both in the waters of the sea and in those of rivers, fish are much like land animals and plants. Of all three there are many varieties. Some are large and some are small; some are useful and some almost useless; some congregate in crowds and some live and grow almost by themselves. There are large trees, such as the pine and the beech; there are large animals, as the elephant and the horse; and there are large fish, such as the shark and the salmon. On the other hand, there are small plants, like the daisy and the violet; there are small land animals, such as the mouse and the flea; and there are small fish, like the sprat and the sardine.

Further than this, there are other ways in which the life of the water resembles that of the land. Some animals, such as sheep and bees, live together in flocks and swarms, whilst many plants grow together in forests and woods. So in the same way we have fish such as the mackerel and the herring, who crowd together in shoals, much as man crowds together in towns and cities.

On the other hand, such animals as the ·ow and the eagle live almost friendless and one; and in the same way there are fish ho keep away from crowded company, and

which are seldom found in the mighty waters of the deep.

The chief fish which are caught around the British Islands, and which are used as food, are the

Herring	**Haddock**
Pilchard	**Sole**
Mackerel	**Plaice**
Whiting	**Cod**
Sprat	**Turbot**

Night and day thousands of fishing-boats of all sizes are engaged in the work. These generally keep together in fleets, so as to be able to render each other help in case of need. In summer and in fine weather the danger is not great; but as these boats are often away from land for days, and even weeks, and as they are exposed to the storms which may spring up at any time around our coasts, the life of a fisherman is a risky and a dangerous one.

In addition to the enormous quantities of fish which are daily caught by the fishermen of our own country, large quantities are sent here from other lands and seas. Most of these however, are preserved, and come here packed either in tins or barrels. Those

which, like sardines, are tinned in oil, are more eaten as helps to appetite than as real articles of food.

Those fish which come in barrels are larger

and more suitable for daily food. In many parts of the world the fish which is caught is cleaned and salted, or cured, as it is called, so that they do not readily decay; and these fish find their way here in vast numbers

and become an important article of trade and food.

The fish which are caught in the rivers of these islands can hardly be said to form a large part of our national food. The rivers are so small and the cities and towns so large,

that all the fresh-water fish seem as nothing when we compare them with the fish taken from the sea.

In England but very few fish are caught compared with those caught in the rivers of Scotland and Ireland, as the numberless fac-

tories make the water too impure for fish to flourish well in them.

The chief fresh-water fish of the British Islands are the

Salmon	**Perch**
Trout	**Roach**
Pike	**Dace**

But the salmon, although it spends most of its time in the rivers, takes an annual holiday for a few weeks to the sea.

Fish to be used as food should, if it be not preserved, be eaten whilst perfectly fresh. Fish is more liable to decompose than meat, and in warm weather rapidly turns bad, as we call it. It is for this reason that ice is placed among the fish in the fishmonger's shop. Stale fish is likely to be decomposing fish, and as such, if eaten as food, is more likely to do harm than good.

Shell-Fish.—This name is wrongly applied to those animals which have shells, and which man takes from the sea for food. They are not fish. The chief used in this country are

Oysters	**Lobsters**
Mussels	**Crabs**
Whelks	**Shrimps**

Except amongst a very few of the poor in lonely seaside houses, these can hardly be looked on as food. They are eaten more as a luxury than anything else. Oysters, however, are very easily digested, and are therefore useful on that account to those who are ill.

VEGETABLE FOOD

Wheat is really grass, and was not always so large a plant as it is now, nor had it always such large grains of seed as it has now. There are many hundreds of kinds of grass in various parts of the world; but although animals eat most of them as food, man saves and grinds the seeds of only eight of them for his own food.

Of these, wheat is most commonly grown. It will grow in hot countries and it will grow in cold; but it will not grow where there are ice and snow nearly all the year round.

In olden times, when men began to use wheat as food, the plant, as has been said, was small and the seed small also. But by careful management, by ploughing and rolling and giving the plant manure, it has been made to grow larger and to be more useful to all the nations of the earth.

If the squeezing of the bag be continued for some time, a sticky, glue-like substance will be found to remain in the bag. This is gluten, which contains nitrogen, and is therefore in the list of tissue-formers or flesh-formers. Thus ordinary bread contains that which the body requires for its growth and its warmth.

But in addition to starch and gluten, bread made from the flour of wheat, contains most of the mineral matter used in the formation of bone; and it is for this reason that wheat and grains of similar kinds are used as food by all the nations of the earth.

Oats give us flour something like wheat, but most of the oats which are grown here and abroad are used as food for horses. Much, however, is used as food by people, especially by those who live in cold countries. In Scotland it is a general food; and it is very likely that it would be a good thing for the people of this country if it were far more used here than it is.

Oats are rather more nutritious than wheat and contain more fat. They also contain much nitrogen; and oatmeal is certainly one of the most useful and muscle making foods we have.

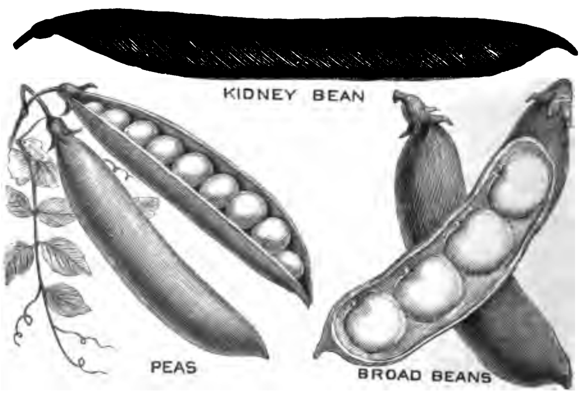
Barley is more grown in cold and temperate than in hot countries. It contains more nitrogen than wheat, and is thus a better muscle-forming food. In this country, however, barley as a food is mostly made into meal for the feeding of pigs, but much is also used for poultry.

Rice forms the bulk of the food of many nations in the hot countries of the world. It is not of much use in forming muscle, but it contains more starch than any other grain. Thus it is one of the best of foods when eaten with other things, such as meat and peas and beans, as they supply the substances which are required for the growth of the muscles, and which the rice can but to a small extent supply.

Beans and Peas.—These differ from wheat and oats in many ways. They are eaten whilst they are young and they are eaten

when they are ripe and hard; but the grains of wheat and oats are not eaten until they are ripe and have been ground into flour.

Beans and peas differ also in the substances of which they are composed, and in the way in which they act in the body after we have taken them as food. They contain more muscle or flesh-forming food than any of the



grains, and a pound of either beans or peas contains more of such food than even a pound of meat.

It is for this reason that they are so largely grown in hot countries, where meat is not much eaten. Meat in hot countries cannot be kept long, and partly for this reason it is not much used. In India the cow is a sacred

animal, and by the Hindoos is never used as food; but although they do eat the flesh of some other animals, they eat but very little, and that not very often.

In such countries, rice and beans and peas, and such-like crops, supply the bulk of the food of the people. The rice supplies most of the starch they require, whilst the nitrogenous food is obtained from the peas and the beans and the lentils. Thus, in such countries, these take the place of meat in supplying part of the muscle or tissue forming food, whilst rice takes the place of our wheat and potato in supplying the starch and heat-producing food.

The great value of beans and peas, or pulse, as they are called, as far as their nitrogen compound, their legumin, is concerned, may be easily seen in the following list, in which the numbers give the nitrogenous matters in a hundred pounds of each :—

Cheese	33
Peas	22
Lean Meat	20
Wheat Flour	11
Rice	5

Thus it will be seen that rice contains the

least material for forming flesh; but from the following list of starchy foods, which are arranged so that those which contain much are placed before those which contain less, it will be seen that rice contains more starch than any other of our ordinary foods:—

Rice
Wheat
Oats
Peas

And these contain more than half their weight of starch.

It must not be supposed, however, that all the substances which our foods contain get into the blood to be used. A great deal depends on our digestive organs, and a great deal depends on the cooking. Ripe and hard peas and beans require long and careful boiling, otherwise much of them is not made use of by us either in the formation of our bodies or in the keeping of them warm.

Wheat, oats, rice, beans and peas are vegetables, as they grow out of the earth; but the word is in daily life applied to such foods as are grown in our gardens and fields, to be used whilst still green or soft.

Potatoes no doubt, in this country, are

more largely used than any other of our market vegetables. Four hundred years ago they were unknown in this part of the world, and, until they were brought here from America by Sir Walter Raleigh, no one in Europe knew that there was such a plant.

Those which we now eat are larger, and far more floury and useful, than those which then grew. By careful farming and gardening new kinds have been grown, so that at the present time there are in England alone more than thirty different sorts.

Three quarters of a potato is water, and the rest is mostly starch, so that it is not of much use in the growth of any part of our bodies. As in the case of most other foods, its value as a food largely depends on the way in which it is cooked; and this was dealt with at some length in the chapter on Cooking in Book IV.

Cabbage.—Under the head of cabbage come most of our green vegetables, such as savoys, greens and brussels-sprouts. More than nine-tenths of these is water, so that these plants are not used as foods on account of their power either to add much to our bodies or to keep us warm. They have, for many years, been

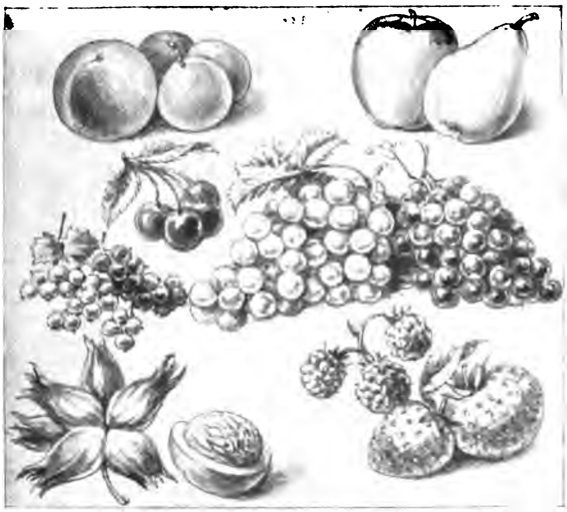
looked on as useful in preventing diseases of the skin, as the minerals which they take up from the earth and carry into the blood, make it purer than it otherwise would be.

Scurvy, the most terrible of all skin diseases, has always been common among sailors and those who have for weeks, and often months, no fresh vegetables as food. From this it has been supposed that vegetables prevent scurvy and other diseases of the skin; but the last voyage of Dr. Nansen in the *Fram* to the Polar regions, would seem to show that scurvy, and other skin eruptions, are due more to tainted meat than to the want of fresh vegetables.

Much, however, must always be said in favour of long-continued custom; and therefore we cannot but look on vegetables of all kinds, as being useful in many ways to us in the preservation of our health.

The rest of our ordinary vegetables, such as parsnips and carrots, are, like the cabbage and potato, mostly composed of water. Each contains something which the others do not; and no doubt they all in some way or other do good, in addition to the good they do in acting on the glands of the stomach and the mouth.

Fruits in this part of the world, are looked on more as luxuries than as foods taken to add to the various parts of the body. Yet they must add a little; and in addition to being agreeable and pleasant to the taste,



they must have some effect on the organs of digestion and on the body as a whole. Their sweets and their sours, their sugars and their acids, all tell their own tale in the blood; and there can be no doubt that

persons who eat no fruits do not enjoy such good health as those who do.

In addition to the fruit grown in this country, enormous quantities are brought from foreign lands. From Spain oranges and lemons come to us by the million; whilst both of them, as well as other kinds of fruit, come to us from almost every warm country in the world.

From America and from Canada apples and pears, both fresh and preserved, are sent to us almost all the year round; whilst from our colonies south of the equator, we obtain their varied summer fruits when it is winter-time with us.

Currants and raisins, the dried grapes of Southern Europe, are used among us at all times of the year, as are also the dried plums and apples of Italy and of France.

MIXED DIET

There are very few animals which live on any one thing. Sheep, which feed mostly on grass, will only too readily eat the plants which grow in the farmer's garden, to say nothing of the plants and roots he specially

grows for them. And it is the same with the cow and the horse.

Wild beasts feed on various animals, or they feed on various vegetables, and all the birds of the air feed on a variety of fruits and seeds and insects. And so it is with the fish of the sea. Most of them no doubt feed on other fish, but these vary in quality and taste; and children, who have ever fed fish in a pond, know that there is little in the way of ordinary food which they will not eat.

And so it is with mankind. Animals of various kinds, and vegetables and fruits of various kinds, they take as food for themselves; from which it appears that it would not be well to live on any one thing alone.

From the various lessons on food which Mr. Creswell gave to his nephew and nieces, it is plain that, as a person's body is formed from the food he eats, the food must contain the substances of which his body is composed. Now a man's flesh and his fat and his skin, as well as all the other parts of his body, are mostly made of carbon, oxygen, hydrogen and nitrogen, and these substances exist in him in different quantities.

Therefore, the nearer his food contains these things in the same quantities as his body con-

tains them, the more perfect will his food be. But neither flesh nor fat, nor bread nor potatoes, nor any other food contains these elements in the quantities in which man wants them.

If a man were every day to eat a pound of lean beef, he would take as much nitrogen as he wanted, but he would only take one quarter as much carbon as he required. If, on the other hand, he were to take four pounds of beef every day, he would get just as much carbon as he wanted, but he would take four times too much nitrogen.

This would no doubt make him ill, as it would cause his stomach to do too much work. And so it would be with other foods. By taking, however, a little of one thing and a little of another, he manages to take as nearly as he can, just the quantity of carbon and of the other substances which he requires.

The amounts of each which are necessary a chemist can now find out for him; but, long before people were as clever as they are now, our forefathers found out for themselves. No doubt. in finding out whether they might eat certain things or not, many of them were poisoned, as many animals even now die from eating things of which they know nothing.

And so, in the same way, by practice our forefathers found out how much of their various foods was good for them; so that they might eat such things and such quantities as gave them the least internal pain, and kept them best in health.

All our food has to be digested, and this is work for our internal organs. So if we take too much of any one thing, whether it be starch or sugar or gluten, or anything else, we give our bodies work to do which would be better left undone.

This is what is meant by a mixed diet. It does not so much refer to mixing lean and fat, and bread and cheese, as to so choosing the elements of which food is composed, that we may give as little work as possible to our digestive and other organs within.

INDIGESTION

Persons suffer from this complaint when their stomachs do not thoroughly do their work, and when food remains so long in them as to cause them frequent pain. Indigestion in itself, is not a disease like small-pox, but shows that something is wrong. The stomach itself may be perfectly sound, but it may fail to press the food on into the intestines.

On the other hand, however, the stomach itself may have been seriously hurt. Hot drinks may have scalded its skin, as hot water may blister the skin of the hand. Medicines or spirits, or mustard or pepper, may also have blistered or hardened its tissues, so that the glands, which prepare the gastric juice, may have been either destroyed or partly prevented from doing their work.

In this case food taken into the stomach is sure to cause pain, as the harder parts of the food come into contact with the diseased parts of its skin. And in addition to pain, further troubles are sure to arise. If the gastric glands do not do their work, the food is not digested; and if the food be not absorbed into the blood, the stomach itself is not properly supplied with nourishment.

Thus a person who has frequent indigestion, will probably go from bad to worse, and should seek the best of medical advice.

WATER

There are few things which we see around us which do not contain water. All the foods of which we have been speaking and thinking, contain a great deal; and we have seen that

fruits such as apples and pears, and vegetables such as cabbage and turnips, are almost entirely formed of it.

The flesh of animals also is largely water. Three-quarters of raw beef is water; and the same may be said of mutton and pork, and of almost all the ordinary meat we eat.

Things, also, which may appear to us to be actually dry, largely consist of water. If we place a lump of dry soda on the top of a hot stove, or on the top bar of a grate, it will melt, and nothing will be left but a thin film of white powder.

Milk and a little cornflour can be easily made by a cook into a firm, almost hard, blanc-mange; yet every one knows that very little flour will have been mixed with the milk, which is nearly nine-tenths water.

And it is the same with animals and plants. About three-quarters of any man or woman or girl or boy is water: so water is the most common thing with which we are brought into contact, hidden as it is in the composition of animals and plants.

And not only do we find water in things which grow out of and walk about on the earth, but we find the air in which they live more or less saturated with water. In dry

air no one could live, as he would be instantly frozen; and even if he were not, he would dry, and become merely a skeleton clothed with a shrivelled-up skin.

Vapour.—The water which is in the air in all parts of the world is called vapour, and vapour is nothing but water and heat. When a kettle of water is left on the fire and forgotten, the water passes out into the air of the house; and, if the weather be at all cold, the windows and painted walls are soon streaming with the water, which the heat of the fire had driven out of the kettle.

If a boiling kettle be closely watched, nothing can be seen close to the spout; but, if a finger be put into the clear space, something which is intensely hot can be easily felt. At a short distance from the spout a cloud of that which is generally thought to be steam can, however, be easily seen. This is not steam, but actual water. Steam is invisible; but that which can be seen as a kind of cloud is, like a cloud, formed of l particles of water.

In the kettle the water took in heat and became steam, and close to the spout it was not to be seen. As soon, however, as it came a short distance away and gave up its heat to the colder air, the steam ceased to be steam and became a mist, a fog, or really a cloud in the house.

And it is the same thing out of doors, where we have the heat of the sun instead of the heat of the fire. When clothes are washed and hung out in the sunshine to dry, the heat of the sun dries out the water from the clothes, and turns it into steam or vapour; and this vapour, if the air be warm, remains invisible.

If, however, the weather happens to be cold, the vapour soon returns to water, and we have a cloud in the open air, as, in the case of the kettle, we had it in the house. This cloud is nothing more than multitudes of minute floating globes of water. If these water particles form high up in the air where it is cold, we speak of them as forming a cloud. If they form close to the earth, we say there is a mist or a fog.

In the same way, when rain falls upon the earth, the heat of the sun again turns it into vapour, which once more floats unseen in the air.

When it is winter in one part of the world

it is summer in another, so that it is always summer somewhere. There particularly the sun's heat dries up water from the ocean, and from everything else which is wet. This vapour floats unseen until it rises to the colder parts of the atmosphere, or until it is carried along by the wind to the colder countries of the earth.

There the vapour loses its heat and turns to rain, so that rain is nothing more than vapour which has lost its heat.

That invisible vapour becomes visible water can be easily proved by boys and girls for themselves. A cold slate held in front of the mouth soon becomes wet, as the warm vapour in the breath gives its heat to the slate and turns to water. In the same way they can easily prove that water becomes vapour, by holding a wet cloth in front of the fire. There that which the sun does to the water of the ocean, the fire will do to the water in the cloth.

Dew.—During the calm warm evenings of summer and autumn, the boots of persons who walk on the grass of our fields and gardens will become wet with dew. This dew is water, which a short time before had been vapour floating in the air. During the warm day the sun draws up or evaporates much of the damp in the earth; but after the sun has set and the air become cool, it cannot hold as much as it did. As the air gets cool it loses heat, and as the vapour loses heat also, it again becomes water and settles as dew on the grass.

Had this chilling of the vapour taken place high in the air, there would have been cloud, and probably rain; but when vapour loses its heat close to the plants and the earth, it does not fall in drops of rain, but settles as dew.

Hoar-frost.—When the roofs of houses and the leaves of plants are white with frost, they are simply covered with frozen dew. During the night the roofs and plants become cold; and as the vapour which touches them loses its heat, it turns to water, which settles as dew.

In summer-time and on the hottest of days, it is possible to obtain dew in our

rooms at home. If a lump of ice be placed in a tumbler of water and stood away from draughts, the outside of the glass will soon be covered with water, which is really nothing but dew. The ice will chill the water, and the water will chill the glass, and then the cold glass will chill the vapour in the air, which will settle on the tumbler as dew.

It is for the same reason that bedroom windows are often covered inside with dew during the cold of winter. The vapour, which leaves the lungs with the breath, comes in contact with the cold glass of the window; to the glass it gives up its heat and becomes water, which, like the dew on the grass, settles on the pane as water.

Ice.—If ice be placed in a saucepan and

put on the fire, it becomes water; so, water is ice which has received heat. When the sun shines on the ice and snow which covers the high mountains, it turns them into water, and this water runs down the valleys, forming rivers and lakes.

If, on the other hand, a saucepan of water be stood out of doors on a cold night, or even on a cold day, the water will lose its heat

and probably turn to ice. And in the same way, if the water which ran from the melting snow and ice on a mountain-top were to lose its heat in the lake below, it would turn again to ice. So whether water shall be water or vapour or ice depends entirely on the temperature.

During all the lessons on foods in the earlier chapters of this book, water seemed to enter

into the composition of all of them. The amount of water was, however, but small when compared with the waters of the mighty oceans and the masses of ice on the mountains.

Three-quarters of the surface of the world is water, and this water is in many places miles in depth. Into these oceans mighty rivers for ever flow, compared with which the rivers of our own land are as nothing.

And besides all this, there are parts of the world where for hundreds of miles nothing can be seen but ice. There snow and ice cover the mountains and fill up the valleys. These masses of ice, many miles in length, now and again float out into the sea, and sometimes drift away as icebergs in the ocean.

From all this, water can be seen to take part in some of the mightiest works of the world, and to take its part also in the growth of its smallest plants. From these plants, it passes into animals as food, and from both it finds its way also into us, of whom it forms the greatest part.

SALT

Common table-salt is not the only substance which is really a salt. There are a great many more to be seen in a chemist's shop; but the name was given to that which we use with our food, long before chemists knew much about the others, so we still speak of it as salt. The earthy matters which harden our bones are salts also.

Our ordinary table-salt is obtained from the sea, and it is also obtained from rocks. It is found everywhere. All earth contains it and all rocks contain it; and it is found in all our foods, whether they come from animals or from vegetables.

Salt is used to preserve things which would otherwise soon decay. A butcher, when he has meat which he fears will not keep, puts it into brine, that is, into strong salt and water. In this the minute animals which destroy meat and fish and vegetables cannot live, so meat placed in salt is saved from destruction by them. Salt is also often rubbed over and into meat to preserve it from decay; and that is also the reason why salt is put into butter, which has to be kept for a length of time.

Salt is dissolved in sea-water, and that is one reason why the sea is never foul. Many of our large towns, and not only ours, but those of other nations as well, are built on rivers, and the sewage of these towns is generally carried away to sea. There the salt of the water prevents it from becoming a nuisance, so that the oceans are really purifiers of the land.

If a spoonful of salt be placed in a tumbler of clean water, some of the salt will be dissolved and will be lost to the eye. It is not lost, however, to the tongue. If the clear water be poured off into a saucer and placed on a hot stove, the water will evaporate or pass away into the air as vapour; but all the salt will remain dry at the bottom of the saucer.

So also, if a saucer of sea-water be served in the same way, some salt will be left in the saucer. Much of the salt we use is obtained from sea-water in this way. In hot countries, where the sun dries up water far more quickly than it does here, large quantities of sea-water are evaporated, and the salt which is left is sold for use.

But in many parts of the world there are rocks which contain little else than salt. In Cheshire, among other places in our own

country, these rocks are found, and there they are dug out and crushed, so that the salt can be dissolved in water. This dissolving in water clears the salt from other matters which may happen to be mixed with it; so that when the water is driven off as vapour, the salt remains for use.

Salt is necessary for all plants and animals. Without it neither would grow. All soils contain salt, and it is found in the ashes of all plants. Men and women and boys and girls take salt with their food, in addition to that which is put into it whilst it is being cooked. All other animals, whether they live on the earth like cows, or whether they fly in the air like birds, require salt to keep them in health; and this salt they obtain from the food they eat.

Salt is found in the air, and it is found in the ocean; it is found in the earth, and it is found in the waters under the earth. It is found in every part of every human being. The blood is salt, the perspiration is salt, and, as every schoolboy knows, the tears are salt also. Everything seems to contain it; and it would be difficult for an ordinary person to name a thing in which it is not to be ɿd.

CONDIMENTS

Condiments include such substances as pepper, mustard, pickles, parsley, sauces, horse-radish and vinegar. They are not taken as foods with a view to build up the body, but because they help the appetite and please the tastes of those taking them. When taken with food, they excite the glands which prepare the saliva and the gastric juice; and thus they cause the foods to be better digested than they otherwise would be.


PEPPER

Thus onions, and all things which are used by cooks to flavour our foods, are condiments; though of course such food substances as they do contain, are used by the internal parts of the body in adding to tissue and in providing warmth.

Pepper grows only in hot countries, and is therefore an import. The pepper plant is a

creeper and grows supported by other trees. Its berries are at first green, and become red when they are ripe; but when they have been dried in the sun they turn black. White pepper is the inside part of the pepper berry, just as flour is the inside part of the wheat grain.

Mustard is obtained from a bushy plant which grows not only here, but in nearly all parts of the world. There are two kinds of this plant which are grown for use, of which one has black seeds and the other white. Like corn, these seeds are ground, so that really the mustard which we have at meals is the flour of the mustard seed.

MUSTARD

If mustard and pepper are taken to help digestion, neither can possibly be wanted by those who are strong, and who can digest their food without this outside help. The plainer the food the better it is for children, and with

them the use of mustard and pepper should not be encouraged.

Tea is the dried leaf of a plant which grows in various parts of the world, but chiefly in Asia. There, in China and in India, the growth of the tea-plant and the gathering and preparation of tea occupy a great part of the population, much as the growing of corn does in this country.

TEA

There the tea plants are grown somewhat after the manner in which currant bushes are grown here. In China, where the towns are very large and not far from each other, there is not much land wasted, and the tea-plant is seen in every district.

No leaves are gathered from the plant until it is three years old; but after this the green leaves are gathered, dried, and curled as we find them.

As there are many kinds of apples and pears in this country, so there are many kinds of the tea plant there; and the prices of the

various kinds of tea differ, as the prices of other things vary elsewhere.

Tea in China, where, as far as we know, it was first used as a drink, is not put into a teapot as with us; but a pinch of tea is put into each cup instead. Over this boiling water is poured, and the tea is drunk without milk or sugar.

The water for the making of tea must be boiling, if we wish to get the full benefit from the leaves; unless the water be actually boiling, certain matters remain in the leaves which would otherwise come out. As tea is not taken as a food to add to the parts of the body, nor to supply any substance which oxygen can destroy and thus cause warmth within, there must be some other reason why so many people have, through so many ages, taken tea as a drink.

As is well known, every movement of our muscles, and everything done by any part of the body, is under the control of our nerves; and many of our nerves are caused to act by various matters which we take as food. Pepper, for instance, affects the nerves of the nose as well as those of the stomach; and in same way, tea affects the nerves of the as well as those of the stomach. That

part of the tea which thus acts is called theine.

Tea further acts directly upon the brain, so that a person who may be worn-out and tired with work or worry, feels more lively and fresh after a well-made cup of tea.

In Russia tea is taken without milk or sugar, but lemon is put into it instead. In America, however, and in Canada and Australia, and wherever Britons have gone to live, tea is made as we make it here.

After boiling water is poured on, it should not be allowed to stand long. Most people know that many leaves and woods and barks when tasted, are extremely bitter, and that this bitter matter hardens and roughens the skin of the mouth. Oak leaves and oak bark contain an extremely bitter substance which is called tannin, and it is this which hardens hides and tans them into leather.

In the same way a bitter brown substance is soaked by the water from the tea, after it has stood for some time; and it is this substance which does harm to those who then drink the tea. This bitter material acts upon and hardens not only the skin of the stomach, but also the food which is put into it; so that a

person who takes tea often is likely to suffer from indigestion.

Day and night throughout the year scores of ships are crossing the ocean with tea. From the docks at the seaport towns the chests are taken by rail to our various cities and towns, and on every pound imported a Government tax is paid.

Coffee, like tea, comes from abroad. It grows in the hot countries of the world, as the climate is too wet and too cold for the tree to grow here.

Coffee is not made from the leaf of the coffee tree as tea is made from that of the tea shrub. The coffee tree grows to the height of twenty feet, and bears clusters of red berries, inside of which there are two green seeds. These are the so-called coffee beans, which may be seen in the grocers' windows; and from which, after roasting and grinding, the coffee we drink is obtained.

As in the case of tea, there are many kinds of coffee. Some kinds grow in one part of

the world, and some in another; and the people who know best how to make coffee always mix two or more of the various kinds.

In this country, however, coffee is not generally well made. Abroad, in coffee-drinking countries like France, it is ground as it is wanted, and is not, as with us, kept ground. There also it is simply treated with boiling water; but with us, as often as not, it is boiled and boiled over again. As a result, boiled coffee becomes spoiled coffee, and some of the benefits which we should otherwise obtain from it are lost.

Like tea, coffee is not taken as a food with any idea of its adding to our tissues or keeping up our temperature. It is taken because its caffein has an effect on the nerves. As is the case with tea, coffee acts rapidly on those who are tired with worry and work, and they afterwards feel more lively and fresh as a result of its influence on them.

By many, however, coffee and tea are often taken at the wrong time. The best cure for those who are tired is sleep, so that the muscles and nerves may be strengthened by rest and the food supplied to them. Sleep gives the nerves a rest, while drinking coffee causes them to act; and those who take coffee

before going to bed can hardly be surprised if they are unable to sleep.

Cocoa is also brought to this country from abroad. The cocoa tree is larger than the coffee tree and far larger than the tea shrub. It often grows to a height of thirty feet. Among its thick, green leaves, cocoa pods grow to a length of four or five inches. These pods look like thick, stout beans, and it is inside these pods that great numbers of cocoa berries are found.


COCOA

As in the case of coffee and tea, cocoa is taken to quench thirst and to act upon the nerves; it is not taken as a food to make us grow. Cocoa does, however, contain a great deal of fat and starch, and is certainly more of a real food than either tea or coffee.

Like coffee, the cocoa beans are roasted, and generally ground before being used. Chocolate is cocoa which has been mixed with sugar and other things to sweeten and harden it. Cocoa by itself is very bitter to the taste.

Tea, coffee and cocoa are the chief things which are used to drink in this country at meals; but during warm weather and during friendly conversations between friends, other common drinks are largely used.

Lemonade and ginger-beer are almost entirely water, sweetened with sugar, and flavoured with lemons or ginger. They are mostly agreeable to the taste, do no harm, and very likely not much good. Still they quench the thirst, which, after all, is the chief reason for taking drink.

There can be no doubt, however, that the great majority of people, especially of men, suffer intensely from thirst in this part of the world; and there can also be no doubt that ten times too much drink is used in quenching it. The best and safest remedy for real thirst is pure, cold water.

THE SKIN

The outside covering of most animals is called the skin. All skins can be stripped off, and from many animals, such as the horse and the ox, the skins are so removed after death and made into leather.

Any one who has skinned a rabbit, well knows that its skin is easily removed; though it is not so easy to remove that of every animal as it is to take off that of a rabbit.

The skins of some animals are thick and some are thin. Those of many animals are not of much use, but most skins can be turned to some use or other. The skin of a horse and the skin of an ox are thick, and these are tanned or hardened into thick leather for the soles of boots.

On the other hand, that of a rabbit and that of a rat are thin, and these are often tanned to be made into gloves and other thin garments for wear.

As is well known, there are five senses, viz., seeing, hearing, smelling, tasting and feeling; and the various parts of the body by means of which we see, hear, smell, taste and feel are connected with the brain by nerves. Therefore the eye, the ear, the nose, the tongue and the skin have nerves.

Of these five, the skin is by far the largest organ, as it covers all parts of the body. As a result of this, the skin must have a great number of nerves; but these are not equally spread over all parts of the body. In some parts the skin is thin and in others it is thick.

In some parts the nerves are numerous, and in others there are but few. We can feel best with the tips of our fingers and the tip of our tongue.

But, although the nerves are most delicate and act best in the tips of our fingers and tongue, our nerves can act in all parts of our body. One could feel about for a thing in the dark with his elbow, or even with his back, if he felt inclined to do so; and this shows that the skin in all parts contains nerves of *touch*. And not only have we in the skin nerves of touch; by contact with the skin we can readily tell whether a thing be hot or cold or wet or dry, so that the nerves of the skin also convey such impressions.

By far the most important work, however, which the skin has to do is to cover and protect the internal organs of the body from danger and from cold. Like the other parts of the body, the skin itself is supplied with blood. As might be expected, being nearer the colder outside air than the internal parts, the skin loses more heat and gets colder. But as it is a *bad conductor* of heat, it does not rapidly allow the heat from inside to pass away. Thus it protects the body from a too rapid loss of heat.

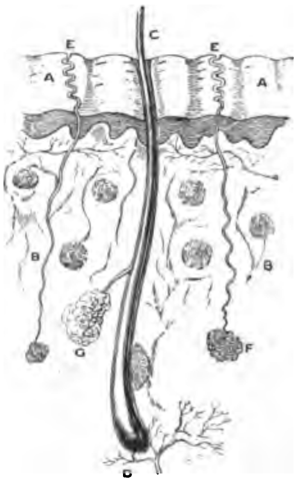
The skin is not equally thick in all parts. On the palms of the hands and the soles of the feet it is thicker than it is elsewhere. The skin also of one person differs in thickness from that of another. That of men is thicker than that of women, and that of persons who do no work, would be thinner and more delicate than that of those who do.

If the skin of the palm of the hand, where it is thick, be cut, it can be easily seen that there is a part of the skin in which there is no blood. That part is the outside. The blood-vessels run in the under part of the skin, and the outer part has neither blood-vessels nor nerves. Thus the outside part of the skin can be cut or scratched without pain and without its bleeding.

From this it can be easily seen that, whilst the whole skin protects the flesh of the body from harm, the outside skin is a *protector* of the inside skin. The real skin is that part which contains blood-vessels and nerves, and is called the dermis. The word *epi* means *upon*, so the outside skin is called the epidermis, because it lies on the real skin, the dermis.

Like all other parts of the body, the skin is continually passing away. Skin stained with

dyes which soap and water will not remove, in time becomes clean, but not until the actual skin is worn away. New skin is also being continually formed inside near the flesh, and that which had been previously formed is forced to grow outward to make room for the new growth. So the outside skin was once inside skin, and is continually being washed or worn away.



Not only is the skin useful as a protection to the body: it is also useful as a purifier of the blood. The sketch will give a general idea of the structure of the skin.

A is the layer in which no blood-vessels are found.

B is the dermis or real skin, in which blood and nerves are found.

C is a hair.

D is a blood-vessel supplying blood for the growth of the hair.

E is a sweat-tube.

F is a sweat-gland.

G is a fat-gland for the hair and skin.

From the outside of the skin, on all parts of the body, thousands of the narrow sweat-tubes lead down into the deeper parts of the skin. There they end in a coil which is in the midst of the blood-vessels. Into this tube, water as well as fatty and other impurities from the blood pass, and thus find their way to the surface. About a pint of water leaves the blood through the skin of an ordinary person daily. Thus the skin is a *purifier* of the blood.

Because the skin allows impurities which we call sweat or perspiration to leave the blood, the skin is an *excretory* organ. The little tubes through which the impurities pass from the true skin to the surface, are a quarter of an inch long; and the skin, taking one part of the body with another and one person with another, is about one-sixth of an inch thick.

Hair.—Hairs grow upwards from their roots, so that the hair, when it is once formed, is pushed outwards by the new hair as it grows. The roots of hair lie in the under-skin, where

they obtain their nourishment from the blood-vessels which there exist among them.

Different nations, and even different tribes of people, in all parts of the world, have different ideas as to how the hair should be treated and worn. Even among ourselves in our own country we do not seem to be all of the same mind, either with regard to its treatment or to the style in which it should be worn.

Those who are well to do and have plenty of time to attend to their personal appearance, can well afford to act in a different way from those who are at work from morning to night. But that all hair should be kept clean, and that the skin of all heads should be kept clean, there can be no shadow of doubt; but whether the hair itself is any the better for being washed, or whether harm is not often done to it by washing, is a point on which all are not agreed.

One thing, however, is very certain, and that is, that the skin of the head, like the skin of other parts of the body, should be often washed. Sweat contains grease, and this settles on one part of the skin as well as on another; and unless this be removed, all the evils which would result from having a dirty

skin on the body would result from having a dirty skin on the head. Large parasites which annoy, as well as small parasites which destroy the skin, seldom stay long where the skin is clean; and as they live and breed in dirt, no dirt should be allowed to stay long on the head.

Washing with warm water and soap is

more certain to keep the head clean than even frequent brushing. But from the skin near the roots of the hair, a natural oil or grease is sent up to keep the hair soft; and if this is continually removed by washing with soap, we must expect the hair to be in an unnatural condition. It is for this reason that to hair which has been washed,

a small amount of oil or grease should be applied lest it get too dry.

The lesson to be learned from the skin supplying grease to the hair, is that soap used for the head and hair should not be strong. Where the water is warm and the soap is weak, it is likely enough that the grease on the head may be removed without hurting the roots of the hair.

Many a good head of hair has been spoiled through acting in the opposite way. All skin does contain fat, and should contain fat; and no soap should be allowed to interfere with this. As long as the fat remains *in* the skin it has useful work to do. Soap, however, contains soda, and soda destroys fat wherever it finds it. If, then, strong soap be used, much soda is used; and this will not only remove the fat which may be upon the skin, but will probably destroy that which is within as well.

This interference by soda with the roots of the hair is likely to do harm; and although the dust and dirt which settle on the skin of the head, together with the sweat which dries on it, should be washed and removed, weak soap should always be used, and not much of that.

Every lady who wears long hair, knows how difficult it is to "keep it up" for a few days after it has been washed. It is within these few days that the natural grease of the hair ascends. Before sheep are shorn they are washed, but they are not shorn as soon as they are washed. If they were, the wool would be nearly useless for the making of cloth. For a few days the shearers wait for the yolk to rise, as they call it, that is, for the natural grease of the skin to grease the wool. And so it is with ladies' hair; they can keep it up after they have waited for the yolk to rise.

Thorough, good, daily brushing of the hair will put off continual washing; and it may often be desirable to wash the skin of the head without much interfering with the hair itself. Whether the hair should be long or short, or whether it should be parted in the centre or not, mostly concerns the wearer. Grass on a lawn which is kept cut short, grows thick; but whether we can say that therefore hair cut short, will grow thick also, is not so equally sure, though probably it will.

With young children, however, there is much to be said for cropping the hair. It saves

much time and trouble; it tends towards keeping their heads clean, and it may help the hair to grow thick and strong. Fashions and customs, however, die hard; and it is likely that for many years to come we shall continue to do as our parents have done before us, and wear our hair long.

Nails, like hair, grow from the lower parts of the skin, and, like it, can be cut without pain, when they have grown away from the skin.

In this part of the world it is the custom to keep the skin clean; but there are parts of the world where this is not the case. In cold countries, where ice and snow abound, there is very little washing of the skin; and many tribes purposely grease their bodies in order to keep themselves warm. Dr. Nansen, who up to 1896, had been nearer to the north pole than any other man, tells us that for fifteen months he never washed, as he had no soap to wash with. Still he remained in perfect health.

In cold countries, however, there is but little perspiration; and, in addition to that, the cold prevents dirty, animal matters from

decomposing and becoming hurtful to those who live there.

In this and in warmer countries, however, it is necessary that the skin should be kept clean and be washed well and often. Among us, perspiration is always going on, and, unless the greasy part of the sweat be removed, it decomposes and causes us to be offensive to our friends.

And not only is this the case. If the sweat-tubes become clogged, the skin does not purify the blood as it should do; and as a result, our internal organs are supplied with impure blood, and our health is not so good as it might be. And besides all this, most of our skin diseases, which are far more common than most people are aware of, are caused by minute animal and vegetable life which comes in contact with and rests on the skin. If the skin be greasy and dirty, these living things find food ready at hand; and not long after, they attack our bodies and feed on the skin itself.

If, however, the skin be often washed with soap, not only is the greasy matter removed from its surface, but the minute animals and vegetables, or parasites as they are called, are removed as well.

Not only does mischief arise through dirt, and the parasites which live in it; the skin is also the chief means by which we take cold. A person who sits in a draught has his skin cooled by the cooler air which blows upon him. Should he turn up the collar of his coat, or by a scarf keep the skin of his neck warm, it is more than likely he will not take cold in the neck.

If, however, a person be sitting in the same draught, who by frequent washing with cold water has accustomed himself to cold, it is more than probable that, without taking special care to keep his neck warm, he will not take cold. He may, but most likely he will not.

But for most people, it is best to prevent the chilling of any part of the body which is not accustomed to cold. For the same reason, people, when they get warm and damp, should not allow themselves to cool rapidly. It is far better to keep on the move and to cool slowly, lest the skin too rapidly lose much heat, and we take a cold in consequence.

In addition to this we should guard against taking cold from draughts; we should be equally careful to guard against taking cold

from wet. Water by itself will not cause us to take cold, as can be easily seen from the good which is done by sea and river bathing. A person who is caught in the rain, and who gets thoroughly soaked, may not take cold as a result. The heat of his skin will in time evaporate the water and dry his clothes; but if his skin is not chilled during the drying, he will not take cold.

Whether a person gets damp from perspiration or from rain, if he take cold as a result, it will be through the skin. The chief thing to do is to keep warm and not to get cold. Working and moving about will keep up the temperature until the clothes are dry. The best thing to do, however, is to take off the wet clothes and to put on dry.

PERSONAL CLEANLINESS

A great man once spoke of dirt as being "matter in the wrong place." This is not quite true, for everything is matter, and many things may be in the wrong place without being dirt. A new hat may be on the table instead of on its peg, but the new hat is not dirt. So in the same way a cook

may by mistake, put sugar instead of salt into a saucepan of boiling cabbage. The sugar is in the wrong place, but it is not dirt.

A girl walking in a garden may bring some of the earth into the house. In the garden the wet earth or mud is not dirt, but on the carpet indoors it is. Paint on a door is not dirt, but smeared on the sleeve of a coat it is. Small dusty coal in a grate and soot in the chimney are not dirt, but either strewn about the kitchen-floor is dirt.

But although it may be hard to *say* exactly what dirt is, it is by no means difficult to *know* what it is. There need be no trouble in knowing whether a person is clean or dirty, and there are but few people who do not know a clean house from a dirty one.

People who are brought up in the country, are generally cleaner in their persons and homes than those who are brought up in towns. In a country village there is less smoke than there is in a large town, and the windows and curtains and clothes do not get so black and dirty as those in towns do.

And in factory towns and cities, where hundreds of large chimneys are continually

pouring out dense masses of smoke and soot, the houses of those hard by cannot be other than dingy and brown.

But in spite of all this, there are far too many dirty people and houses. Water is the great enemy of dirt; and with plenty of water and plenty of will, things might be far cleaner and brighter than they are.

A dirty person is almost sure to have a dirty house, and a dirty house is certain to bring up a set of dirty children; and as these go out into the world, dirty habits and customs are spread.

From what was said in the chapter on the skin, the cleanliness of the person is largely mixed up with health. Water and soap are sufficient for this; and persons who are careful about their appearance and health, are not likely to be careless about the appearance of their homes.

Nails.—By nothing is a man or a woman, a boy or a girl, more quickly judged than by the nails. Growing like hair from the deeper layer of the skin, they daily grow longer and longer. Nails should be regularly cut and trimmed, so that they may not be a danger either to ourselves or to others.

In addition to the danger which would arise

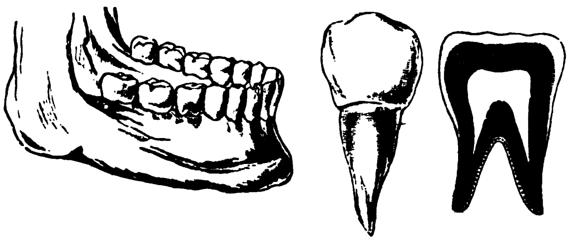
were nails grown to the length of claws, they are apt to gather up dirt from the things which we handle and use. This dirt should be regularly removed; and no one can be said to

be clean whose nails are not seen to at least once in the day.

Teeth.—A person with dirty teeth is a person to be avoided, for no one who is forgetful of his teeth is likely to be particular over anything else. And not only should they be

seen to for the sake of appearance. Good health depends on good digestion, and no food is thoroughly digested which is not well acted on by the teeth.

As a result, the better the teeth the better the health, and the better they are attended to the longer will they last. Teeth are formed of compounds of lime, which are taken in with the food, and compounds of lime are rapidly



destroyed by acids. A sour apple causes the teeth to be "set on edge," that is to say, it causes them to feel as though they had been sharpened.

Not only is this the case with apples. Any sour fruits and vinegar will act in the same way. That acids act thus on teeth can be easily proved. If a tooth of a bullock or a sheep be obtained from the butcher, and a little vinegar poured over it, bubbles of gas

will be seen to arise from the surface of the tooth, and in time the tooth will be eaten away or destroyed.

This can be shown equally well with an oyster-shell or with a lump of chalk. These two substances, like teeth, are made of compounds of lime, and what happens to one when touched by acid happens to the other.

Teeth, however, may be destroyed without vinegar or any other sour foods coming into contact with them. When any of our ordinary foods decay, whether they decay whilst still in the house or when they are buried in the earth, carbonic acid is sure to be formed; and if food be left either on or between the teeth, this acid, and others as well, are sure to make their appearance.

It is on this account that so many people have bad teeth. The fault is largely their own, or that of their parents, who have not insisted on the teeth being cleaned whilst their children were young. The acid, when formed, dissolves the surface of the teeth, and thus they are gradually worn away.

Any one who has an idea that this is merely information for books, should prove this for himself with vinegar and a shell. The wearing away or dissolving of the teeth may not

be done in a day, but it as surely happens for all that.

For this reason, if for none other, the teeth should be cleaned every day, and oftener if time permits. Water, not too cold, and a good tooth-brush will work wonders with the teeth; but as so many things daily come into contact with them, they should occasionally be cleaned with a powder as well.

Many of the tooth-powders which are sold in shops are bad for the teeth, and clean chiefly by destroying their surface. Camphorated chalk should never be used, as camphor, by soaking into the teeth, does little but make them brittle. Any powder which is harsh and gritty should be avoided. Pure chalk thoroughly ground is a perfect powder, and does not act chemically on the teeth to destroy them.

And besides the decay of teeth which often arises from not keeping them clean, there arises the danger of cracking them by heat and cold.

If boiling water be suddenly poured into a tumbler, the glass will often crack; and if a gas-flame be suddenly turned too high, the lamp glass will often crack.

So if a tumbler be made warm and then

put into ice-cold water, as likely as not the glass will crack; and it often happens that, during the cold of winter, gas lamps, and even window panes, crack without being touched, on account of the extra cold.

The enamel of the teeth is brittle like glass, and is often cracked, unknown to us, by hot liquids and foods. In the same way, through bringing ices or other cold things into contact with the teeth, the enamel is often caused to crack, although we may know nothing about it at the time.

As time rolls on, however, acids and other matters cause these cracks to enlarge; and it is to this cause that bad teeth and toothache are often due.

Clothes.—No one can be said to be clean whose clothes are more dirty than they need be. Those who have to work for their living at dirty trades, cannot be expected to keep their clothes as clean as those who do not. Dirty things cannot do other than soil the hands and clothes of those who daily handle them.

This dirt, however, need not remain on skin and clothes for ever. Soap and water will do

much for the skin, and soap and water will often do as much for the clothes. A daily brush for the dust on outside garments, and an occasional wash for the grease, make all the difference between a clean and a careless man.

But whatever may be said for the outside clothes, nothing of the kind can be said for those inside. There they come in contact with the skin; and the skin is continually giving out matters which grease and dirty the linen and cotton and wool which come into contact with it. This grease and dirt decay, and with the decay, impure and offensive gases pass away from the person upon whom they are allowed to remain.

It is a knowledge of this which has caused the weekly wash. No inside garments should be worn for a longer time, and the more often they are changed the better for those concerned.

By this means the air surrounding a person becomes purer than it otherwise would be; the lungs have a better chance to purify the blood, and the skin itself stands less chance of disease.

Bedroom.—This matter of clothes is closely connected with that of our houses, particu-
' rly the rooms in which we sleep. All that

can be said in favour of a weekly change of clothing which comes near the skin, can be said in favour of a weekly change of linen for the bed. This also comes into contact with the skin, and for the sake of cleanliness and health it should be frequently changed.

Through the skin, impure matters pass out from the blood, and the same can be said for the lungs. This passage of impurities is always going on, so that a person who is shut up for hours at a time in a single room, must make that room impure, whether the room be upstairs or down.

From the skin of an ordinary person, a pint of water during twenty-four hours passes into the air, whilst in the same time a half-pint comes from the lungs. As this water is always in company with worn-out parts of the body, it is very plain that our bedrooms are certain to become impure.

It is for this reason that all sensible people open their bedroom windows when they arise in the morning, and keep them open as long as the air outside is dry. By this means foul air passes out, and the oxygen of the air which enters, destroys the impurities which may happen to remain.

This world, however, is very imperfect, and

we cannot always have things as we wish, or even as they should be. In a country like ours, where, as a rule, it is weather and not climate, we have often to choose between two or more evils. The decaying matter of a bedroom and impure air make up one evil; and damp, a great enemy to man, is another.

As both damp and bad air are hurtful to health, one has to choose between them; and as probably more mischief is done by the damp than by the bad air, its entrance into our homes must be guarded against. It is on this account that, except for the most robust and healthy, it is as well in damp weather, not to open the windows in early morning.

By waiting until the cold and damp of night have partly passed away, or, as they say in America, "until the sun has dried the streets," bedroom clothes and beds themselves can be kept drier than they otherwise would be. In this way diseases of the lungs and colds can be to a great extent prevented.

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